INDUSTRIAL ENGINEERING

with which is consolidated

INDUSTRY ILLUSTRATED

Electrical, Mechanical and Plant Service in Industry

Published by McGraw-Shaw Company—Division of McGraw-Hill Publishing Company, Inc.

Volume 86 NEW YORK, DECEMBER, 1928 *Number 12*

The Value of Recorded Experience

. . . All progress, economic, social, industrial, is evolved from experience; and it is on the recorded experience of the past that we are able to build for the present and the future.

. . . In the ruins of ancient cities buried in the South American jungles, we have evidence of an ancient civilization whose very existence had been thought legendary. In Egypt, in Mesopotamia, in Herculaneum, even here on our own North American continent, exploration and excavation are under way: seeking to unearth and to reconstruct the stories of lost or forgotten races and civilizations.

. . . Human bones, pottery, objects of art—these, to the skilled scientist afford a means for painstakingly building up a picture of the unknown.

. . . When, however, in addition to such relics, the explorers come upon inscriptions on stone or on gold or parchment or papyrus—these are a priceless find. *These* are *facts;* written records; something definite as distinguished from mere speculation; a concrete contribution of recorded experience to add to the total of human knowledge.

. . . Engineering science, in common with every other science, has been built upon this same basic foundation: the accumulation of recorded experience.

. . . Not so long ago, "engineering" implied primarily what we now call civil engineering. With the growth of the literature of recorded experience, engineering knowledge grew and expanded; developed branches, mechanical, electrical, civil, chemical, and—partaking of several of these—industrial engineering.

. . . In each division or branch of engineering, the text book and the hand book, each a compilation and digest and application of recorded experience, form the foundation of our knowledge.

. . . Progress is so swift, however; developments are so rapid; that it is to the technical publications serving his particular field, that the engineer must turn for a solution of his day-by-day problems.

. . . With his technical training as a foundation, he has as working tools his reference books and his own ingenuity and initiative. To round out and supplement these, to keep himself abreast of day-by-day and month-by-month developments, he must look to the technical periodical, for a presentation of the recorded experience of today.

How to Correct

Low Power Factor

By OTTOMAR H. HENSCHEL

Consulting Engineer
Milwaukee, Wis.

NO ONE knows how much yearly tribute industry pays to low power factor, but that this toll is unnecessarily high can not be denied. And yet, detection of this condition and the application of effective remedies are a simple matter. In this article an authority on the subject tells how to check up the power factor of the plant system and what to do about it if it is too low.

IN EVERY industrial plant that uses either locally-generated or purchased alternating current the matter of system power factor is of considerable consequence. Obviously, in some plants, due to the type of equipment employed and the operating conditions that exist, a fairly high average power factor is encountered, whereas in others, an exceedingly low power factor exists.

In case electrical energy is purchased the consumer is penalized, directly, or indirectly for low power factor. Likewise is he penalized when making his own power; not by the utility company but by himself. In addition, in either instance, when the power factor is low the consumer may suffer all the effects of unnecessarily heavily overloaded mains and feeders, excessive copper losses and resulting poor voltage regulation. In general, unless the power factor of an industrial plant system is comparatively high, let us say 80 per cent or more, heavy losses and much inconvenience are almost certain to be sustained.

Why is the power factor of the average industrial plant system low? Because, the bulk of the energy-consuming equipment is ordinarily inductive in nature and, in turn, this condition is aggravated by the presence of many underloaded squirrel-cage type induction motors. However, these motors are not the only offenders. There are also transformers, arc lamps, electric welding transformers, induction furnaces, and so on, each of which has its own detrimental effects. The accompanying table indicates the power factor usually obtained with various types of a.c. apparatus.

Unless means are provided by the utility company supplying energy, where purchased energy is used, for determining the power factor, the consumer must secure this information. No haphazard methods should be employed; one of the most suitable methods involves the use of a graphic power factor recorder. Naturally, this meter should be connected at the point of service entrance and the longer it is allowed to remain so connected the more detailed will be the information secured. However, where a general survey is being made and the plant is operating normally two to three months should suffice, using the monthly average as a working basis.

On the other hand, it is possible, although not quite so convenient, to obtain the desired results by the use of the public utility's instruments. Some companies install recording or graphic power factor meters for this purpose while others use an integrating reactive component meter in conjunction with the regular kilowatt-hour meter employed for measuring the consumed energy.

With this scheme instantaneous, hourly, daily, weekly or, preferably, monthly readings may be taken and the ratio of the reactive component meter reading to the kilowatt-hour meter reading secured. From these figures the power factor may be readily determined as illustrated by the chart in Fig. 1.

For example, let us assume that only instantaneous readings are taken; that is, note is made of the number of disc revolutions of the reactive component meter for each 10 disc revolutions of the kilowatt-hour meter. Under the further assumption that these instruments carry like constants, if the reactive component meter disc makes, let us say, 6 revolutions, the ratio R/P, where R is the number of reactive component meter disc revolutions and P is the number of kilowatt-hour meter disc revolutions, is equal to $6 \div 10$, or 0.6 expressed as a decimal.

Referring to the chart and follow-

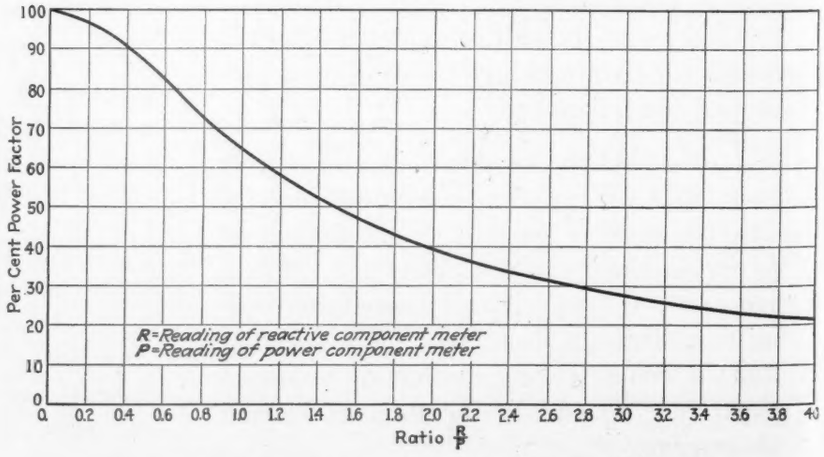


FIG. 1—WHEN THE RATIO of the readings of the kilowatt-hour and reactive component meters is known, the power factor can be determined from this chart. Trace upward along the line representing the ratio of the two readings to the point of intersection with the curve, and read the percent power factor at the left.

ing from 0.6 upward to the point of intersection with the curve and tracing to the left, it is evident that the power factor at the moment of taking readings was somewhat more than 82 per cent.

On the other hand, let us assume the reactive component meter to have registered 1,400 within a given period, and the kilowatt-hour meter 1,000. The ratio R/P would obviously be equal to 1,400÷1,000. Again referring to the chart, Fig. 1, and following upward from 1.4 to the curve, the intersection shows an average monthly power factor of 52.5 per cent.

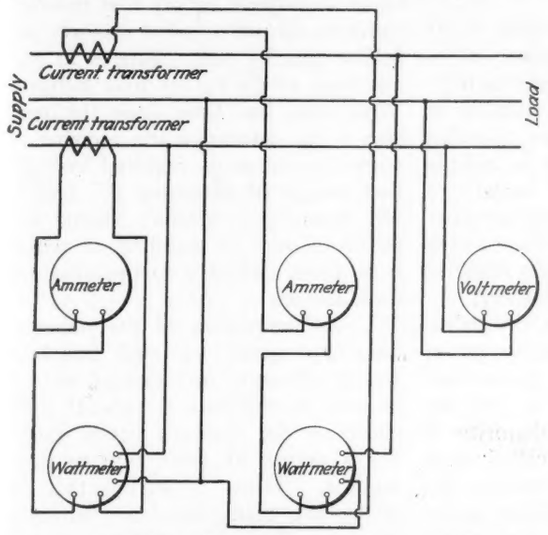


FIG. 2 — CONNECTION scheme for ammeters, wattmeters, and voltmeter used in making a load survey to determine load and power factor of motors.

Segregation of the various sources contributing to this condition is the next logical step. This in itself constitutes, or should constitute, a complete survey of the entire equipment, especially if all of the units are of the inductive type.

The start of this survey may be made with any unit, but in order to make it of value it is absolutely necessary that suitable instruments be available. Taking the case of any three-phase motor which is practically a balanced load, the necessary ammeters, voltmeter and indicating wattmeters should be provided and connected as shown in Fig. 2. With these instruments in circuit it is readily possible to determine, first, the actual load being carried by the motor (this from the wattmeter readings) and, second, the power factor by transposition of the regular formula,

$$P = \sqrt{3} \times E \times I \times \text{p.f.}$$

wherein P is the power in watts, E the normal line voltage, I the current flow in amperes and p.f. the power factor expressed as a decimal. Obviously then, where all of the factors are known and the power factor is desired it is given by the formula:

$$\text{P.F.} = P \div (\sqrt{3} \times E \times I)$$

where, as before, the power factor, p.f. is expressed as a decimal.

In Fig. 3 is a typical test sheet indicating the results of a test made by means of indicating ammeters, voltmeter and wattmeters as just explained. The motor under consideration was a 10-hp., 440-volt, three-phase, 60-cycle, four-pole, 1,800-r.p.m unit driving a Bliss No. 78½ straight-side power press. As will be observed, readings were taken and recorded under various load conditions and the total kilowatts, kilovolt-amperes, power factor, horsepower input and horsepower output determined therefrom.

Tests of this kind will well serve their purpose, but in the opinion of the writer more satisfactory results may be obtained by the employment of the recording wattmeter, a typical record from which is shown in Fig. 4. With an instrument of this kind the actual performance of the unit is shown pictorially, with all variations in load indicated. For all practical purposes no power factor meter is necessary, as this value can well be determined in a simple manner by the alternate disconnection of the potential leads, the observation of the resulting two readings and the determination of the ratio between them. This ratio is then transferred to a chart supplied by the meter manufacturer, from which the per cent power factor may be read directly.

In the instance just cited it is apparent that little if anything could be done to better the motoring of the press or the power factor, so far as motorization is concerned. However, let us take into consideration another case.

This also refers to a Bliss No. 78½ press, directly belted to a 25-hp, 440-volt, three-phase, 60-cycle, 850-r.p.m. squirrel-cage induction motor. The horsepower output of the driving motor ranged from 5.66 to 5.9 with corresponding power factors of 44 and 46 per cent, respectively.

That this unit was an offender contributing to the system's low power

FORM 2388—3.7.21—3000

MOTOR TEST REPORT

Customers Name Federal Pressed Steel Co. Address Hoffman Ave. & No. Pine
Test Required for or by Mr. J. C. Miller Location of Motor In Press Room
Date 9-8-26 192

NAME PLATE DATA OF MOTOR

Size 10 HP. Make Mech. Appl. Volts A.C. 440 Amps. Per Term 13. R.P.M. 1720
Phases 3 Cycles 60 Type K.H. Form A Style Serial No. 44904
Poles 4 Connected Belted Motor Is Running → Clock Wise
Type of Starting Device Switch Make — H.P. — Serial No. —
Diam. of Motor Pulley 8" Face 6" Bore Keyway
Motor Is Connected To 36" Fly wheel On No. 89 Bliss Press.

	VOLTS			AMPERES			KILOWATTS		TOTAL K. W.	K. V. A.	POWER FACTOR	H. P. INPUT	% Input E. P. Output	R. P. M.
INSTRUMENT NO.														
SCALE														
MULTIPLYING FACTOR														
PHASES	1&2	2&3	3&4	1	2	3	No.	No.						
MOTOR FIELDS														
MOTOR FREE RUNNING														
MOTOR & SHAFTING														
LOAD No. 1	470	470	470	17.		17.			17.4	1385	895	1664	1464	
" No. 2	470	470	470	7.		7.			4.8	569	.844	6.43	5.66	
" No. 3	470	470	470	6.5		6.5			4.0	528	.757	536	472	
" No. 4	475	475	475	8.0		8.0			5.6	657	857	7.5	6.6	
" No. 5														
STARTING CUR. MAX. SWING														
MAXIMUM LOAD														
NORMAL														

SHAFTING LOAD CONSIST OF FT. OF DIAM. SHAFTING RUNNING AT R. P. M. & FT. OF DIAM. AT R. P. M.
LOAD No. 1 CONSISTS OF Bliss working maximum reading
" " 2 " " " going rope " "
" " 3 " " " " Anchor " "
" " 4 " " Fly wheel Only
" " 5 " "
" " 6 " "
MAX. LOAD CONSISTS OF Loading Very Intermittent.
NORMAL LOAD CONSISTS OF
REMARKS: This test is based on maximum readings
TESTED BY Buiggemann APPROVED BY

FIG. 3—THIS is a convenient form for recording the results of load tests on motors.

factor is obvious and, as a result, a 10-hp. motor was ultimately installed in its place and a power factor of 80 to 83 per cent secured.

This is only one example of the benefits to be gained by the correct motoring of machines.

Going over a plant unit by unit and remotoring wherever it is found to be necessary, the final result will naturally be a general improvement in the average monthly system power factor. However, because of the nature of the loads that are almost certain to be encountered, it is unreasonable to expect that all motors can at all times be made to operate at or even near rated capacity. Likewise, neither can it be expected that the maximum power factor can be secured even by a practically perfect motorization of a plant, except possibly in some unusual installations.

What may be expected is shown in Fig. 5, which shows a typical monthly power factor curve of a pressed steel plant in which the power factor had originally been approximately 32 per cent. In this case, as remotoring proceeded the power factor was gradually increased as shown to about 40 per cent, then to 67 per cent and eventually to somewhat more than 70 per cent. Naturally the unit or cents-per-kilowatt-hour cost varied inversely with the per cent power factor maintained, the decrease being from an average of 3.8 cents to 1.9 cents, or a reduction of 50 per cent.

While the average reduction in unit cost was secured it should not be inferred that the total power cost was reduced by this amount. In the final analysis of the problem consideration must be given, as in this case to such items as total kilowatt-hour consumption, demand both measured and billed, and also any coal factor addition or deduction which might be involved.

In some installations the matter of correct motoring may be simple, whereas in other cases it may be quite complex. In one plant the correct type of motor may be employed, thereby resolving the problem into one of securing only the proper horsepower rating. On the other hand, it may be that a plain, squirrel-cage induction motor is being used on a job actually necessitating a special, high-torque type of machine in order to allow of the minimum horsepower rating.

The writer has in mind a number of power press drives in which originally 20- to 30-hp. motors were employed, although tests conducted revealed the fact that only about 5 hp. were really required after the press was once set in motion. As a trial, a 7½-hp. motor of the squirrel-cage type was installed, but this proved to be utterly unable to meet the demands placed upon it, as it lacked the required starting torque.

The problem then resolved itself into one of securing a motor of 5- to 7½-hp. rating, but of high-starting-torque characteristics. A number of motor manufacturers were appealed to, but only one was able to comply with the specifications: namely, a motor having high starting torque—17 per cent slip—and a torque rating of 6.7 hp. This machine was installed and proved entirely satisfactory.

Without desiring to cast any reflections whatsoever upon utility power salesmen or those having power factor corrective equipment to sell, the fact remains that in the majority of instances when they are called in to assist in raising a system power factor, they will use the existing power factor as a working basis. Apparently they fail to realize the fact that much can be done by first seeing that all machines are properly motored. Unless this is done it will become necessary to purchase a corrective device of considerably greater capacity than is actually required.

It is highly advisable for anyone who is planning to correct the power factor of an industrial system to make a complete survey first in order to locate all underloaded motors, and follow this by such changes in size and type as the survey may indicate. When this has been done the next step is to determine the amount of corrective capacity required and the best means of obtaining it. Generally speaking, it means: Should static condensers be installed, or would it be more desirable to use synchronous motors?

Upon completion of the remotorization program — if such has been found necessary and carried out—it is well to maintain a careful daily check on the system's power factor for a period of from two to three months. Then, if during this interim, the plant has been normally operated the average thus secured may well be taken as the basis for determination. However, it is well,

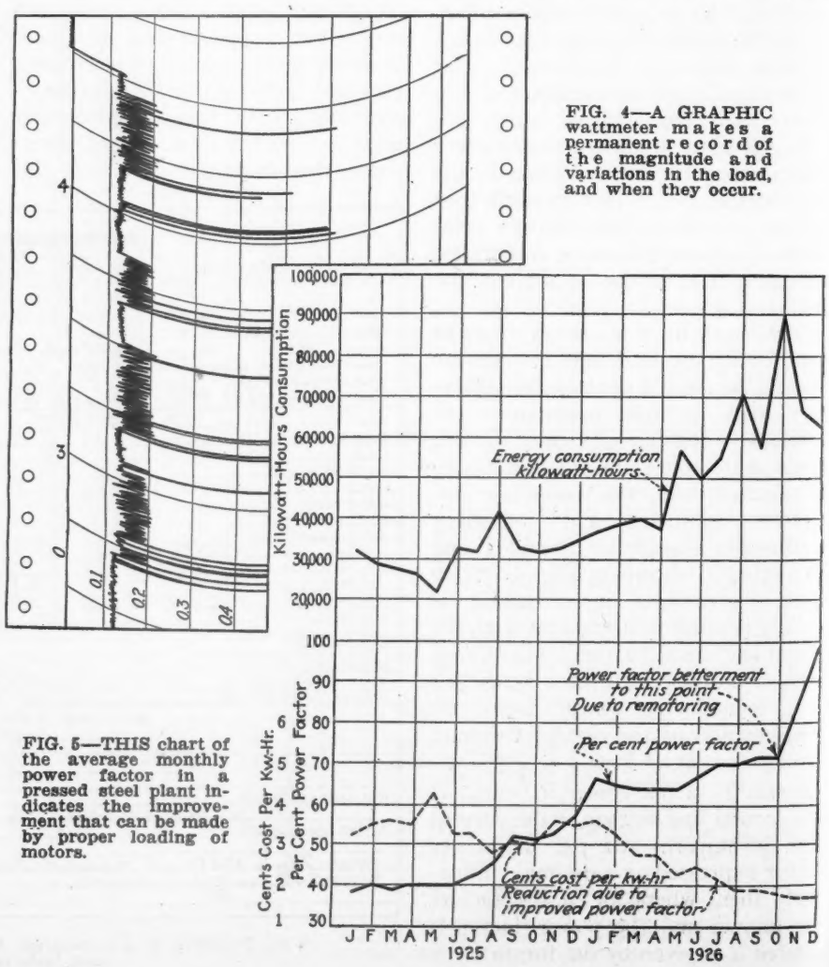


FIG. 4—A GRAPHIC wattmeter makes a permanent record of the magnitude and variations in the load, and when they occur.

FIG. 5—THIS chart of the average monthly power factor in a pressed steel plant indicates the improvement that can be made by proper loading of motors.

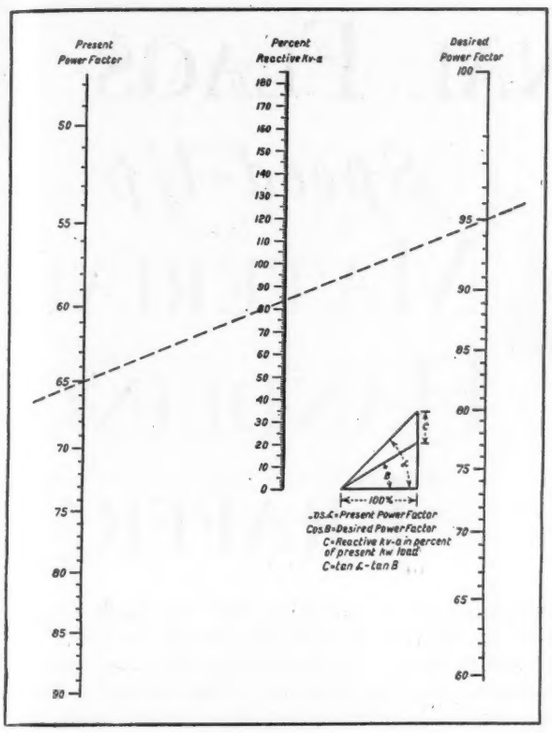

Present Power Factor
Percent Reactive Kv-a
Desired Power Factor
100% Present Power Factor
Cos B=Desired Power Factor
C=Reactive Kv-a in percent of present kw load
C=tan A-tan B

FIG. 6—USE THIS chart to determine the percent of reactive kilovolt-amperes required to raise the power factor to the desired value. The procedure is explained in the text below.

unless possible of fairly close estimation, to have some knowledge of the demand in kilowatts upon the system. Naturally a demand meter represents the best means of securing this information, and it is advisable to use a graphic instrument, as it gives a permanent record.

Then, having in hand the value of the average normal power factor and the average demand in kilowatts, we can proceed to determine the per cent of reactive kilovolt-amperes required to raise the power factor to the desired value.

In Fig. 6, is shown a chart which can be employed for this purpose. Assume, for example, that it is desired to determine the per cent of reactive kilovolt-amperes necessary to raise to 95 per cent, the power factor of a system operating at 65 per cent, and that the average demand is 130 kw. Placing a straightedge, as indicated by the full line, so as to extend from existing power factor of 65 per cent, in the left-hand column, to the desired value of 95 per cent in the right-hand column, we find the intersection with the middle column to be approximately 84 per cent reactive kva. According to this, then, 0.84 times 130 or, 109.2 reactive kva. are required. For all practical purposes this would be equal to 110 reactive kva.

Other problems involving different percentages of existing and desired power factors may be solved likewise.

Inasmuch as the object of this article is primarily to illustrate a few ways in which an existing low system power factor may be corrected, the application of either a static condenser or a synchronous condenser will be considered briefly. The actual selection of either of these devices is difficult to take up in a treatise of this type for, after all is said and done, the correct choice is dependent not only upon the relative economy of the types of unit involved, but also upon local service and plant operating conditions. In general, each plant presents its own peculiar problems.

As a matter of information, the advantages of static condensers as presented by Charles R. Underhill in his book entitled "Power Factor Wastes," are the absence of moving parts, ready installation either indoors or out of doors, small attendance requirements, noiseless operation, little floor space required for small sizes, high efficiency, practically no maintenance costs, low-temperature operation, and ease of connection to, and disconnection from, service lines.

On the other hand its limitations may be mentioned as:

1. Correction cannot be varied except by cutting units in or out.
2. Correction decreases with fall of voltage, although these variations are usually negligible.
3. Corrective capacity is always leading and so is applicable only to lines with lagging power factor.
4. Requires more floor space in the larger sizes than other types of corrective device.
5. Higher first cost in larger sizes which, however, may be offset by lower operating costs.

The synchronous condenser should be given due consideration especially in installations where mechanical drives are involved with constant-speed loads and infrequent starting and stopping. In this type of service may be mentioned motor-generator sets, air compressors, rock and ore crushers, ammonia compressors, centrifugal, rotary and reciprocating pumps, pulp grinders, jordans, chippers, rolling, cement, rubber and flour mills, conveyors, blowers and fans.

APPROXIMATE POWER FACTOR OF COMMON TYPES OF INDUSTRIAL A.C. EQUIPMENT

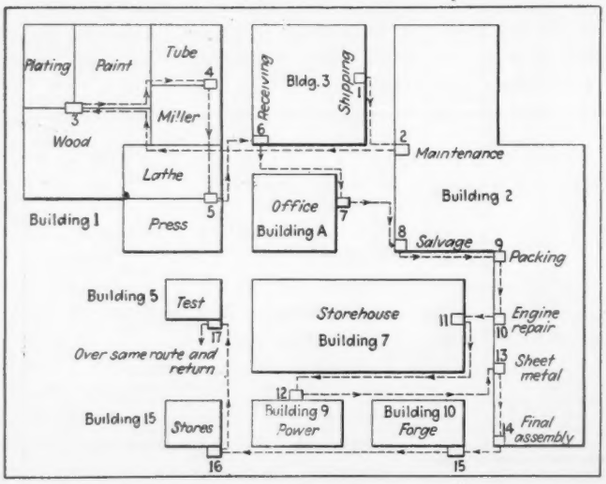
Apparatus	Power Factor Per Cent	Remarks
Incandescent lamps	90 to 95	With small step-down transformers
Single-phase induction motors with squirrel-cage rotor:		
1/20 to 1 hp	55 to 75	At rated load
1 to 10 hp	75 to 86	At rated load
Polyphase induction motors with squirrel-cage rotor:		
1 to 10 hp	75 to 91	At rated load
10 to 50 hp	85 to 92	At rated load
Polyphase induction motors with phase-wound rotor:		
5 to 20 hp	80 to 89	At rated load
20 to 100 hp	82 to 90	At rated load
Arc furnaces	80 to 90	
Induction furnaces	60 to 70	
Welding transformers	50 to 70	
Synchronous motors	Adjustment between practically zero power factor leading to zero power factor lagging.	
Rotary converters, compound wound	Power factor at full load can be adjusted to practically 100 per cent.	
Rotary converters, shunt wound	Power factor can be adjusted to any desired value: should not be operated below 95 per cent power factor at full load.	

Truck with trailer at transportation head-center ready for scheduled trip.

SIGNAL FLAGS *Speed-Up* MATERIAL HANDLING TRAFFIC

THE use of electric handling trucks for internal factory transportation is fairly well established in most large plants. A regular express route with specific shipping points for each sub-division or shop, greatly simplifies the work. To carry this out, there is designated for each sub-division of the plant regularly requiring transportation facilities, a shipping point through which all requests for the facilities will come, and to which all transportation personnel will go to secure information covering the material to be used. In general, for the shops, these will be the sub-storerooms most advantageously located.

The express route employed for all normal shipments by a firm having a branch plant in Philadelphia, Pa., is continuously followed by one truck making at least three round trips each morning and four each afternoon. This truck, with sufficient trailers, follows through to the final destination and returns over the same route.



THE ROUTING followed is illustrated in the accompanying diagram, the arrowed dotted line showing the actual route traveled. Where the routing is internal to a given building, the lane travelled is bounded by red lines, so that it is kept free at all times and the trucks will not be blocked or interfered with. Special material or material from a single shipping point so great in quantity or bulk as to overtax the capacity of the express truck to handle on a regular trip, is taken care of by a special trip on telephone request to the transportation section by a regular designated shipping agent.

* * * *

GROUPS OF TRAILERS at right loaded and ready for distribution on scheduled route.

Each shipping point is provided with two flags, and a bracket on the outside of a building along the route on which to mount them. The place where the brackets are set is known as the "flag location." The red flag is used when the material is on hand for a point on the outbound leg of the route (relative to the starting point); the blue flag, when the material is for a point on the inbound leg. The route is definitely mapped and distributed in the form of a table as shown.

E. L. FAIRALL.
Philadelphia, Pa.

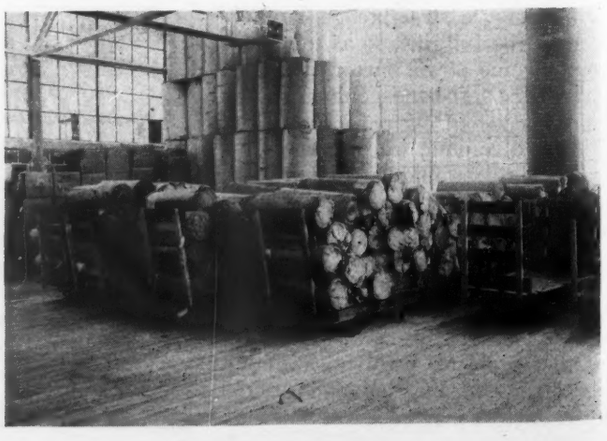
RED ROUTE

Outbound Leg (READ DOWNWARD)		Flag Location	Shipping Point	
Shipping sec.,	Bldg. 3	E. side	Shipping sec.	1
Maintenance,	Bldg. 2	Door 2	Office	2
Wood shop,	Bldg. 1	Door 4	Sub-stores	3
Paint shop,	Bldg. 1	Door 4	Sub-stores	3
Plating shop,	Bldg. 1	Door 4	Sub-stores	3
Tube shop,	Bldg. 1	Door 4	Tool crib	4
Machine (millers)	Bldg. 1	Door 4	Tool crib	4
Machine (lathes)	Bldg. 1	Door 4	Tool crib	5
Machine (presses)	Bldg. 1	Door 4	Tool crib	5
Receiving section,	Bldg. 3	W. side	Rec. section	6
Office,	Bldg. A	Rear door	*	7
Salvage section,	Bldg. 2	Door 5	Salvage sec.	8
Packing shop,	Bldg. 2	Door 6	Sub-stores	9
Engine repair,	Bldg. 2	Door 6	Sub-stores	10
Store house,	Bldg. 7	Door 11	Storehouse	11
Power house,	Bldg. 9	N. side	Bldg. 9	12
Sheet metal shop,	Bldg. 2	Door 3	Sub-stores	13
Final assembly,	Bldg. 2	Door 8	Sub-stores	14
Forge shop,	Bldg. 10	S.E. cor.	Forge shop	15
Inflammable store,	Bldg. 15	S.E. cor.	Stores	16
Test section,	Bldg. 5	N.E. cor.	Test	17
Inbound leg				

BLUE ROUTE

Inbound Leg (READ UPWARD)

* Delivery point ONLY. Shipments are handled on telephone calls to Transportation Section.

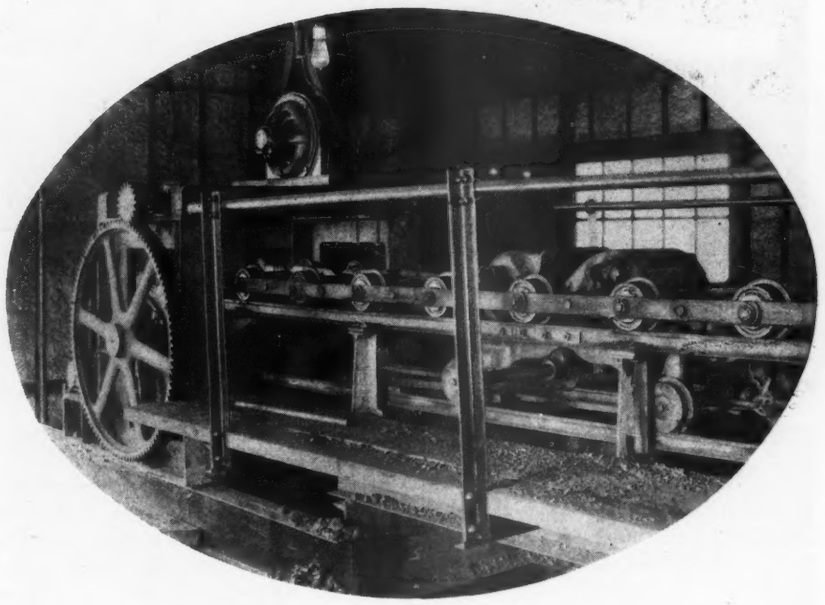


How Service Dictates CONVEYOR DRIVE SELECTION

IN THIS ARTICLE the author tells how to avoid the evils of misapplication. What motor to use for retarding conveyors and for conveyor systems that must operate at the same speed.

By R. F. EMERSON
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

A SQUIRREL-CAGE MOTOR drives this pivoted bucket conveyor. The capacity is 25 tons an hour.



IN A PREVIOUS article in the May issue, the characteristics of the common type of conveyors were discussed, along with the kinds of service to which they are best adapted. In this article motors and control equipment for conveyor services will be discussed.

All types of conveyors have certain characteristics in common. One of their common attributes is their high friction load. The ordinary types, such as belt conveyors, scraper conveyors, and bucket conveyors have a large number of bearing surfaces, which in the aggregate constitute a large proportion of the load on the driving motor.

Another common characteristic is the tendency of conveyors to "stick" when starting up. This characteristic is particularly pronounced in cold weather after a conveyor has been shut down for several hours and the lubricant has settled down or become frozen. As a result of this tendency of a conveyor to stick it has been common practice for conveyor builders to over-motor their conveyors, so as to make sure that the motor will always be strong enough to overcome the static friction and get the conveyor running. Inasmuch as squirrel-cage motors are quite commonly used for driving conveyors, the result is low efficiency for the motor and low power factor on the mains supplying power to induction-motor driven conveyors. In other words, it requires a considerably greater pull to get the machinery started than is required afterwards to keep it going.

The use of ball or roller bearings in the various idlers of a belt conveyor will assist considerably in reducing this tendency of a conveyor to stick. With sleeve bearings the static friction is high after a long shutdown because the oil is gradually squeezed out and there is a broad metal-to-metal contact where the shaft bears on the sleeve.

Tests taken on a belt conveyor 400 ft. long, using a 42-in. belt and sleeve bearing idlers, shows that the starting torque required at the motor pinion was equal to 177 per cent of the torque required to operate the conveyor under full-load conditions. The use of anti-friction bearings in the idlers would doubtless have resulted in a considerable decrease in the torque required to break the static friction. Also, the running friction would probably be reduced by using anti-friction idlers, although the gain here would not be so great as in the case of the static friction.

This is brought about by two causes. First, the sleeve bearing lubricates itself after a few turns of the shaft and its friction decreases after establishment of the oil film, whereas the ball or roller bearing has a metal-to-metal contact at all times, and the difference between static and running friction is not so great. Second, the speed of operation of belt conveyor idlers is comparatively low,

and in some installations their lubrication is neglected. Greater advantages in the way of reduced friction are gained in an installation of this sort by installing anti-friction bearings than in installations of some other types as, for example, in certain ratings of induction motors where the total friction loss may be only a fraction of 1 per cent of their total output.

The advantage of reduced friction through the use of ball or roller bearings is greatest with horizontal conveyors. As the angle of incline increases, the power delivered by the motor is used for elevating the material as well as for overcoming friction. At very steep angles the major portion of the power supplied may be used for elevating and the effect of anti-friction bearings is not so pronounced, as far as any saving in power is concerned.

THIS SCREW CONVEYOR in the plant of a milling company is driven by a squirrel-cage motor through a speed reducer.

* * * *

Any one of the types of conveyors previously described may be used as a retarding conveyor. A retarding conveyor is one that conveys material down grade, where the grade is steep enough to overhaul the motor. Retarding conveyors are usually belt conveyors and the motor is used to break static friction and get the conveyor going. As the conveyor accelerates to normal speed, its descending load gradually takes the load off the motor until finally the load overhauls the motor, which then acts as an electric brake and holds the conveyor at a constant speed.

If a d.c. motor is used, a shunt-wound motor is best because its speed changes very little with changes in load. In fact, it is the safest d.c. motor to use with a retarding conveyor. A compound-wound motor will gradually speed up as its load is reduced and, when it is overhauled, its speed will be considerably higher than the full load motor speed. For this reason it is undesirable for use with a retarding conveyor.

A series motor also speeds up with decreasing load and there is no limit to its speed when it is overhauled. In fact, it will destroy itself by its excessive speed. For this reason a series motor should never be applied to this kind of service.

If an induction motor is to be employed it is permissible to use either a standard squirrel-cage, or a wound-rotor motor. In either case, the speed with 100 per cent regenerative load will be only about 3 per cent above the synchronous speed of the motor.

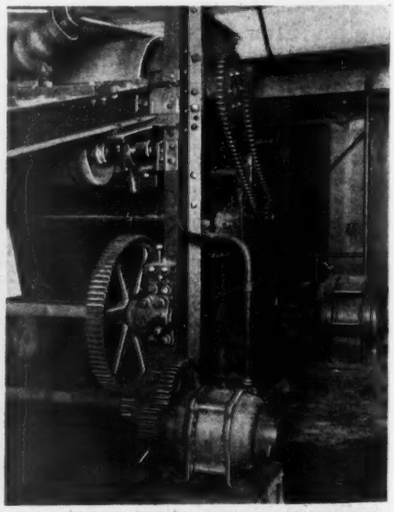
* * * *

The above statements are made on the assumption that the motors are connected to the line with full voltage across their terminals, and with no resistance in the motor circuits. If, however, a retarding conveyor is operated by a wound-rotor motor with a large amount of resistance in the motor secondary, or if a shunt motor is used with resistance in series with the armature, the load may overhaul the motor and the speed will be so great that a runaway condition will result. Similarly, if a squirrel-cage motor is started with a compensator and is left on the reduced voltage tap, the overhauling load may exceed the breakdown point of the motor and cause excessive speed.

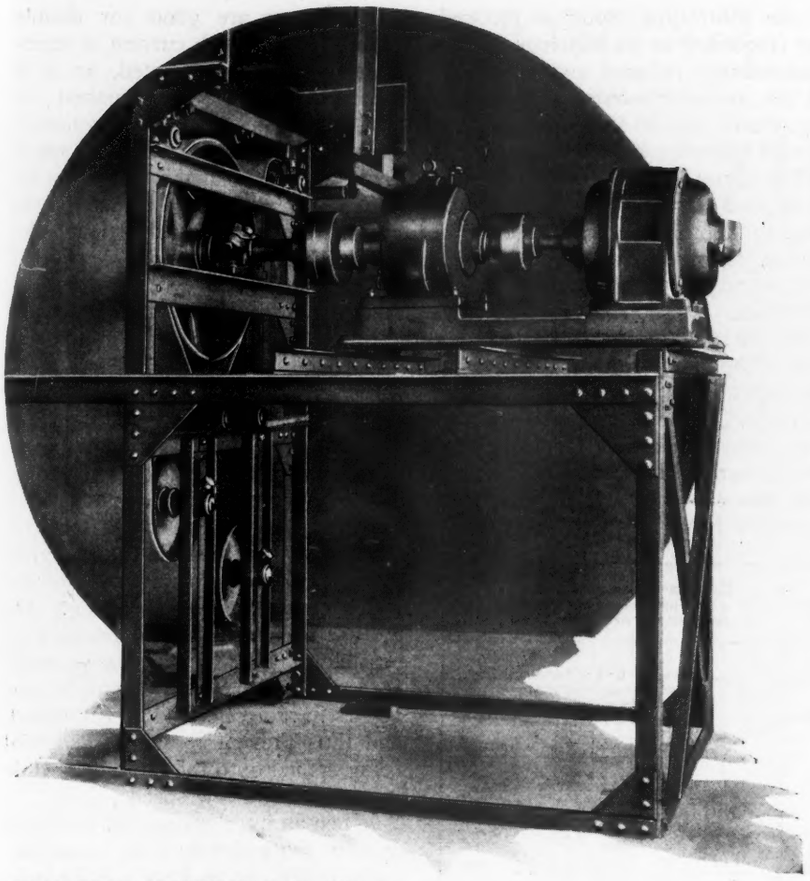
It is, therefore, to be recommended that with a motor driving a retarding conveyor, a speed limit switch always be used that will shut the motor down at a certain over-speed condition and cause a solenoid brake to set, thus bringing the system to rest.

Without doubt, the ideal way to start a conveyor is by means of a wound-rotor motor and a drum controller. The operator can apply torque gradually by notching the controller around point by point. As the torque increases, backlash is taken out of gears, and belts tighten up until the torque overcomes the static friction and the machinery moves without shock. However, because of the desirable qualities of sturdiness, simplicity and absence of all brushes and slip rings, the squirrel-cage motor has been justly popular with conveyor manufacturers, particularly for the smaller installations.

Unfortunately, this type of motor has a lower torque at starting than it has after it gets to running. In other words, the most unfavorable part of the motor's torque curve occurs at zero speed, which is the very point where the highest torque is required for conveyor drive. This is shown in the chart on page 630 by comparing curves *A* and *B*. Using a wound-rotor motor, it is possible to get practically any starting torque from zero up to the maximum torque of the motor. This is indicated by curves *C*, *D* and *E*. Curve *C* shows a value of torque that is not quite high enough to start the conveyor. Curve *D* indicates just enough torque to start the conveyor, and curve *E* indicates the maximum torque the wound-rotor motor can exert at zero speed.



DRIVE CONNECTIONS for a belt conveyor and crusher. Squirrel-cage motors are used on both applications.



FLAT BELT CONVEYOR for handling flour bags, driven by induction motor through a spur-gear speed reducer.

* * * *

Considering now the speed-torque curve, *F*, of the double squirrel-cage motor, it will be seen that its greatest torque is at zero speed, which is exactly the place where it is most required for overcoming the tendency of the conveyor to stick, and to get it moving. As soon as the conveyor starts to move the torque exerted by the motor decreases and follows somewhat the torque curve of the conveyor itself.

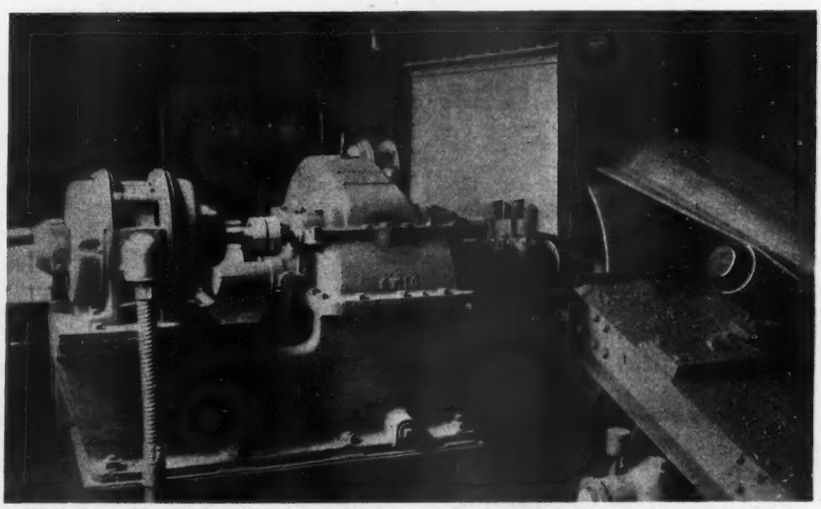
It will be noted also that this motor has a lower maximum running torque than the general-purpose motor. This is a help in those cases where a starting compensator is used with a belted motor. Sometimes the sudden increase in torque when changing over from the partial to the full-voltage tap, with a general-purpose motor, causes the driving belt to jump off. With a double squirrel-cage rotor the increase in torque will not be so great as when a general-purpose motor of the same rating is used.

The use of the double squirrel-cage motor for conveyor drive should be particularly acceptable to central stations because conveyor builders invariably over-motor their conveyors when using general-purpose, single squirrel-cage motors. The conveyor builder considers it cheap insurance to use a 25-hp. motor to insure starting under all conditions of operation, whereas the actual running load on his conveyor may be as low as 15 hp. The reason for this is entirely due to the poor starting torque of the single squirrel-cage motor, as illustrated by curve *B* in Fig. 2. This means that a motor so applied is running at a little over half load, and the power factor will be much poorer than if the motor were fully loaded. The resultant effect of a large number of underloaded induction motors on a central station's power lines may have considerable effect on its generating capacity.

Although the double squirrel-cage motor inherently has a lower power factor than the general-purpose motor, it will be much better at full load than that of the general-purpose motor at half load. The double squirrel-cage motor is identical in appearance with the general-purpose motor and has the same general characteristics of simplicity and sturdiness, the only difference in most ratings being in the rotor winding. There is, therefore, now no excuse for overmotoring conveyors when using squirrel-cage motors.

In cases where any kind of squirrel-cage motor is started by a compensator and the motor is equipped with a solenoid brake, care must be taken to provide an auxiliary switch on the compensator that will release the brake on the partial voltage tap of the compensator, as otherwise the motor may have to drive against the brake while it is on the starting tap.

It is permissible to start the double squirrel-cage motor on full voltage. In doing this, consideration should be given to the method of connecting the motor to the conveyor mechanism. If a silent chain drive is used, the chain manufacturer should guarantee his chain against the sudden torque which



HERE A BELT CONVEYOR is driven by an induction motor through a herringbone gear speed reducer.

* * * * * * * *

the motor exerts; also the chain should be kept at its proper tension so as not to whip or jerk when starting. Most conveyors start very infrequently and after they have started they run for considerable periods.

However, there are some applications, such as ice conveyors, that start and stop a great number of times in the day's run. In such cases care must be taken that the control contactors can break the current without undue maintenance attention. Also, the general-purpose induction motor, with its high inrush current, is hardly suitable and a high-resistance squirrel-cage winding should be used that will give the requisite starting torque, keep the inrush current down to a reasonable value, and still not allow undue heating in the rotor windings. The proper motor design in this case can be determined only by submitting the following information to a reputable motor manufacturer.

Load on motor when running.

Equivalent WR^2 at motor pinion of all moving parts.

Duty cycle, giving time periods when carrying load and remaining idle.

Sometimes it is essential that a number of conveyor systems operate at absolutely the same speed. This can be accomplished by operating each conveyor system by a wound-rotor motor, and applying to the sliprings of these motors double frequency and voltage obtained from the sliprings of a controlling motor. If the speed of the controlling motor is reduced, the frequency at its sliprings is correspondingly reduced and the speed of the conveyor motors will likewise be reduced, but all the conveyors will remain locked in step.

For example, assume that 60 cycles is applied to the stator of the controlling motor. If this motor is stalled, the frequency in both stator and rotor will be the same: namely, 60 cycles. As soon as the rotor turns over, the rotor frequency becomes less and if the motor runs at exactly synchronous speed its frequency is zero. However, if we drive the rotor in the reverse direction from which it would ordinarily run the frequency will rise above 60 cycles, and if the motor is brought up to synchronous speed, in reverse direction, the rotor frequency will be 120.

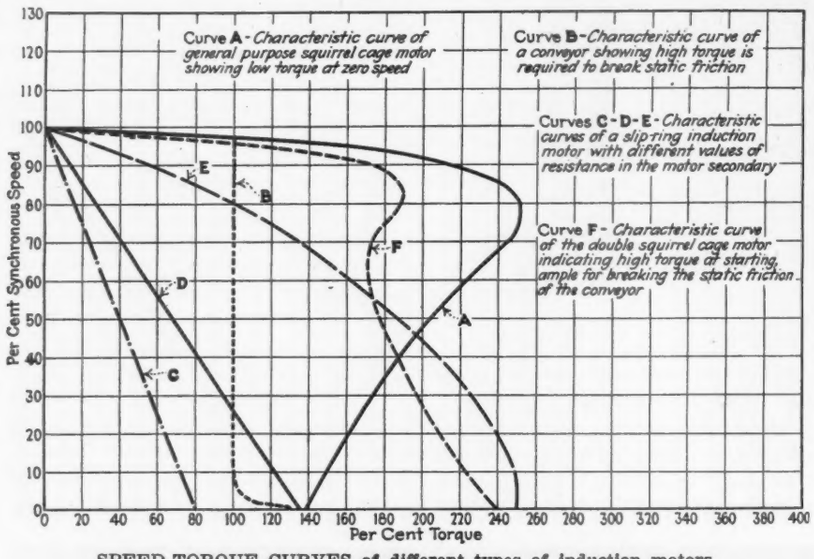
Now, if this double frequency is applied to the sliprings of any number of conveyor motors, the stators of which are connected to the same 60-cycle supply as the controlling motor, the conveyor motors will all lock in at synchronous speed, and varying the speed of the controlling motor will vary the speed of the various conveyor motors.

In a system of this kind the following points should be noted: The controlling motor must have a capacity equal to the sum total of the ratings of the various conveyor motors. The motor manufacturer must be consulted to make sure that the rotors and brush riggings of the conveyor motors are good for double voltage. The inrush current at starting should be investigated, as it is rather heavy for this method of operating. Advise the motor manufacturer regarding the minimum speed of operation so that the motor can be checked for increased heating due to reduced ventilation. Investigate the maximum starting torque demanded by the various conveyors in the system, because excessively high torque will cause the conveyor motors to drop out of step.

Electrical control for conveyors lends itself admirably when it is desired to start conveyors in sequence. Depressing a start button will cause the sequence of any number of conveyors to start, one after the other; also, it is possible to use signal lights at various places to indicate which conveyors are operating. By the use of interlocks and relays it is possible to delay the starting of small feeder conveyors until the main conveyors have accelerated to full speed, and thus prevent too much material being spilled onto the large belt while it is running at low speed.

When an interlocking belt conveyor system shuts down, it is sometimes quite important to have all the belts stop at the same time so that material will not be spilled onto a stationary belt by one that has not yet coasted to rest. In one large conveyor system this was accomplished by applying flywheels having different values of stored energy, so that the belts would come to rest in the proper sequence.

Practically all conveyor builders have standardized formulas, diagrams, or curves to indicate the power required for driving conveyors. These data take into account speed, angle of incline, weight of material carried, width of belt, and whether sleeve or anti-friction bearings are used. A rule-of-thumb method for determining the horsepower required to operate a conveyor is to take 2 per cent of the number of tons per hour carried for each 100 ft. of horizontal belt length. In case the conveyor is inclined, an additional 1 per cent should be added for each additional 10 ft. rise of incline. The estimated horsepower should also be increased 5 per cent for each driving reduction through chain belting or cut gears, and by 10 per cent for each reduction through rough gears, in order to obtain the final horsepower at the motor pinion. This is a very rough approximation and is not at all accurate for all types of belt conveyors but represents average conditions.


Curve A - Characteristic curve of general purpose squirrel cage motor showing low torque at zero speed
Curve B - Characteristic curve of a conveyor showing high torque is required to break static friction
Curves C - D - E - Characteristic curves of a slip-ring induction motor with different values of resistance in the motor secondary
Curve F - Characteristic curve of the double squirrel cage motor indicating high torque at starting, ample for breaking the static friction of the conveyor
Per Cent Synchronous Speed
Per Cent Torque
0 10 20 30 40 50 60 70 80 90 100 110 120 130
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400
A
B
C
D
E
F

SPEED-TORQUE CURVES of different types of induction motors. Curve *A* represents the characteristic curve of a general-purpose squirrel-cage motor. Curve *B* shows the torque requirements of a typical conveyor. *C*, *D*, and *E*, are characteristic curves of a wound-rotor motor with various values of resistance in the secondary circuit. *F* is the characteristic curve of a double squirrel-cage motor.

* * * * * * * *

AROUND THE WORKS

Alcohol Facilitates Window Washing in Cold Weather

WHEN it is necessary to wash windows in cold weather, difficulty is experienced in preventing the water from freezing before it is squeezed off. Of course, this work is usually postponed during cold weather, but condensation and dust frequently make it desirable to wash the inside at least. In extremely cold weather, the water will freeze even on the inside. Using hot water will, to a certain extent, permit inside washing, however, adding alcohol to the washing water gives a non-freezing mixture which can be used either outside or inside.

It is better to apply this solution to the window with a brush, instead of a sponge, so that the men do not have to place their hands in the water, because of the low temperature. Also, some denatured alcohols are poisonous and so should not be used on the hands.

Chicago, Ill. E. D. F.

Nuggets from the Junk Pile

MEN charged with the maintenance of machinery and supplies sometimes miss valuable chances to save money for their employers and win notice for themselves.

During the time that I was a machinist for a large lumber mill and railroad in New Mexico, the master mechanic went out to one of the water stations of the railroad. Work being slack in the shop I was looking around, and found under a lot of old pipe back of the shop several brass globe valves and iron bodies of large-sized valves. Digging them out, I could see nothing the matter except cut seats, stripped stems, etc.

To kill time more than anything else, I rigged an angle plate to the lathe and faced off seats, made new stems where necessary and fitted them with new disks, then dumped them in a bin in the stock room.

A few days later a valve failed in the boiler room and the pipe fitter was storming around because it would take over a week to get a replacement from Denver. I showed him my job lot of valves that had been reclaimed and he quickly made use of a 6-in. type. The superintendent on looking at the new supply said, "saved about three hundred dollars," and walked out. The master mechanic would not have resigned about a month later except for the incident of the valves. W. E. HASELTIME.

College Park, Ga.

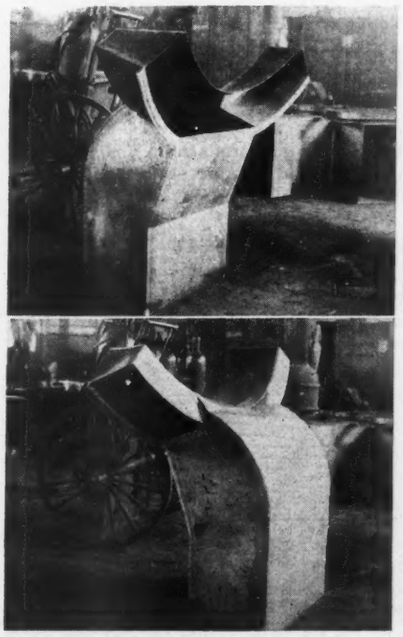
THIS SECTION *is especially devoted to short articles describing ideas and practical methods devised to meet particular operating conditions. The items may refer to mechanical details of installation, inspection, testing, wiring, repair, maintenance, replacement, and emergency or unusual installations of equipment tributary to production. Special attention is given to shop or bench tools and short cuts or improved methods of handling work brought into the repair shop. Contributions from our readers are always welcome.*

* * * *

Odd-Shaped Ventilator Duct Easily Made by Gas Welding

IT WAS estimated in the steel plant where the ventilator duct shown was produced that to fabricate a similar piece of equipment by riveting would have cost three times as much for draftsmen's work, twice as much for preparation, 30 per cent more for material, 50 per cent more for labor of production and four times the production time than this oxy-acetylene welded unit. This duct was built under the direction of the foreman of the welding shop from a rough pencilled sketch together with accurate measurements.

New York, N. Y. W. I. G.



FRONT AND REAR VIEWS of odd-shaped ventilator duct fabricated with oxy-acetylene outfit from rough sketches.

Portable Storage Battery Use and Abuse

IN MANY plants the maintenance electrician is called upon to take care of storage batteries of the portable type, such as are used on motor cars and on some signal systems. This type of battery is usually encased in a rubber jar with a sealed cover, thus making it impossible to inspect the inside of the cell while it is being used.

During my several years of experience with this type of battery, I have noticed that the shop in the average plant does not have a complete set of battery instruments and the maintenance man is, in this case, obliged to use his best judgment and often trust to luck when caring for the batteries.

It is quite common to see storage batteries charging or boiling on the charging bench for, perhaps, many hours after the plates have reached their full charge or voltage. In most cases of this kind it will be found that, in spite of continued charging, the specific gravity has failed to rise above 1.250. In the meantime, the life of the battery is being boiled away, the plates become soft and the active material falls away from the structure of the grids.

In such cases, if voltmeter as well as hydrometer readings are taken, a comparison between them will indicate when the battery is fully charged, before it is injured from excess charging. However, slight variations in the readings, which are due primarily to the character of the plates and the electrolyte, can be expected.

As the electrolyte of the battery should not be strengthened before it is ascertained that its plates are fully charged, I prefer first of all to put the battery on the line at its proper rate of charge until all cells are gasing freely. Then reduce the charging rate about one-half for a few hours or until the voltmeter and hydrometer readings case to increase. At this point it would be safe to consider the battery as being fully charged.

Should the specific gravity reading average 1.250, it is advisable to replace the old solution with new electrolyte that has a specific gravity of 1.400. Due to the dilution caused by weak acid that is retained in the separators and the plates, the hydrometer readings will now drop to about 1.280 or 1.300. These readings should be taken at about 70 deg. F., although it is sometimes more convenient, if the specific gravity of the liquid is between 1.250 and 1.300, to draw off a small quantity of the weak acid and replace it with a corresponding

amount of new electrolyte. The individual cell can now be adjusted separately according to the hydrometer readings, for all the plates have been brought up to their full charge.

If the acid has been in the battery for more than three years, it is best to completely renew the acid in all cells, but do not try to wash out this class of battery without first removing the plates or groups.

Due to the limited amount of space for free acid in portable batteries, the specific gravity is usually carried rather high. It, however, should never go beyond 1.300 with fully charged plates. When it is convenient to keep the battery charged or floating on the line, I prefer to keep the specific gravity as low as 1.225, which value of specific gravity corresponds to that commonly maintained in large power batteries.

When the batteries have wooden separators, which is commonly the case with portable batteries, the high specific gravity has a rapid deteriorating effect on the separators, and this condition is to be found every day with automobile batteries. Many repair men blame this condition to overcharging, but from my experience I place the blame entirely to high specific gravity. Many a storage battery with separators found in good condition has fallen to pieces from overcharging, although the specific gravity has not risen above 1,200.

Perhaps the most common disease of portable storage batteries is what is known as sulphation. In most cases it is caused by neglect in keeping the battery fully charged. A storage battery, whether it is in use or not, should be kept fully charged or as nearly so as possible. Claims are made for certain chemicals, for removing sulphate, but from my experience I prefer to remove it by applying a slow overcharge, and being careful not to allow the temperature of the battery to rise above 90 deg. F. Although some claims have been made that good results have been obtained by charging the cells in the reverse direction, care should be taken not to carry the reverse charge too far.

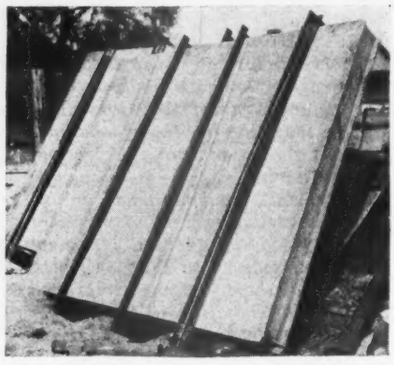
In taking voltmeter readings of the batteries while charging or discharging, be careful to take the readings directly at the batteries and not at some remote place on the line. The voltmeter wiring should be independent of all other wiring, in order to obtain a dependable reading of the actual battery voltage.

As the life of the batteries depends very largely on the accuracy of the voltmeter and hydrometer, the need of good meters cannot be overstressed. At present I am using a Weston moving coil voltmeter that has a full scale reading of three volts. It can only be used on the individual cell, consequently, the undercharged cell can be readily selected. If your voltmeter is of the portable type, attach to it a pair of flexible leads to which have been soldered a pair of prick points as these will insure a good contact even on corroded terminals.

R. G. MACAULEY.
Electrician,
Canadian Fish & Cold Storage Co., Ltd.,
Prince Rupert, N. C.

Unique Bracing Method Insures Rigidity in Flat-Bottomed Tank

IN ORDER to stiffen the bottom of a flat-bottomed tank the method shown in the accompanying illustration is used by a nrm of welding contractors.



BUILDING-IN RIGIDITY in flat-bottomed tank by means of welded trussed angles.

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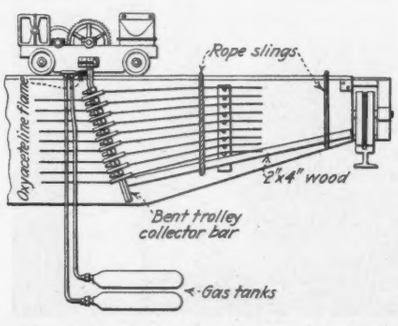
A frame of angle iron and plate is welded to fit across the bottom and along the sides. The angles are trussed with a ½-in. rod. This is welded to a spacer in the center, heated with the welding blowpipe and slightly bent until it can be welded in position at the two ends. The ends are then welded firmly in place, the slight contraction which takes place after completion of welding serving to put the member in tension.

W. I. GASTON.
The Linde Air Products Company,
New York, N. Y.

Method of Straightening Crane Collector Bar

IN THE foundry of a large plant a 10-ton crane is one of the key pieces of equipment. One morning when everything was in readiness to meet a heavy schedule, the trolley collector bar on this crane became badly bent. During a difficult maneuver the operator had struck the stops too hard, so that the trolley wires were jarred out of their rests. Ignorant of this condition, the operator moved the trolley in the opposite direction. Collector shoes and wires became entangled with wire rests, so that the collector bar was bent close to the bracket.



LET THE TROLLEY supply the force necessary to straighten bent collector bars on cranes.

On previous occasions the procedure in putting the collector in operating condition again was to substitute a new bar, or straighten the old one. In either case, from two to four hours' time were spent in getting the parts from the Spares Department, or having the bar straightened in the blacksmith shop, and changing and adjusting the collector shoes.

On this occasion, a delay was particularly undesirable; so one of the crane repair crew suggested that the bar be heated with an oxyacetylene flame close to the bracket. This was done, and when the bar was hot enough it was easily straightened, without being removed. The collector shoes fitted with practically no readjustment, so that within 20 min. after the accident the crane was in operation again.

The bar was not, of course, straightened with great accuracy, but it was close enough for all practical purposes, and has not caused any trouble during a year of operation.

Another improvement was introduced later on. Instead of bending the bar by hand, a 2x4-in. stick is now suspended by ropes so that one end rests against the end of the crane and the other bears against the lower end of the bent bar. The trolley is then used to supply the force for bending the bar straight, thus making the job easier.

Inasmuch as there are a large number of cranes in other departments of this plant, and similar accidents occur at fairly frequent intervals, this method of straightening collector bars has resulted in a large saving of time and money.

Baltimore, Md. J. GRATIOT.

Suggestions on Inspection of Elevator Cables

FROM a safety standpoint the systematic inspection of elevator cables cannot be overlooked. One of the most commendable practices is to follow the safety codes of some of the states and cities. New York City has probably the most complete code of that kind as a natural result of the vast number of commercial and passenger elevators in buildings and the peculiar conditions existing. A code book entitled "Safety Code for Elevators," which costs only 65 cents may be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York, N. Y., and should be in every maintenance library. If these codes err, it is on the side of safety, which is a good fault.

There is a rule for counting strands that may or may not appear in some of the codes. At any time that 12 broken wires can be counted in tracing around the cable at any given point, the cable must be replaced. Another rule for different stages of wear is the rejection

of the cable when 5 wires are broken and 12 are worn half-way through at any given point. This may be expressed differently as 4 broken wires and 16 worn half-way through. The thought is to get the equivalent of approximately 12 broken wires or less.

Cables should be renewed every five years anyway, according to the strictest of codes. Many cable users will object to this ruling and, in truth, the inspector might well review the individual case before ordering replacement. The principle on which this is based is the hardening ("crystallizing," as it is commonly termed) of the wires with time and the reverse bendings which causes a brittleness that might result in sudden fracture of too many wires. This might take place just after an inspection and the elevator pronounced safe for another six months.

If cables are run beyond the five-year period, they should be inspected with increasing frequency. There are many installations in factory and merchandise buildings where the elevators are not run more than once or twice a day, for example. The cables on them cannot get the sheave wear that cables on elevators running constantly do and the replacement in a specified time does seem to be an unnecessary hardship. If frequent inspections are made, it seems to the writer that a longer period of service should be realized.

Cables that show one of the strands puckering out from the rest should be replaced at once. This loosened strand is a sign of a break that has escaped the notice or of a strand that was not properly seized and has pulled loose at one of the ends. In either case, the cable has lost just that much strength —⅓ of the original, in a six-strand cable. (Common usage sanctions the term "cables," but the trade name is "elevator hoisting rope" or just "hoisting rope").

The two principle causes for rope rejection are breaking wires and chafed surfaces; the latter finally merges into the former. Many sheaves are too small in diameter. It will often pay to replace these small sheaves with larger ones because of the reduction in the renewal expense.

With elevator cables there is no period of lowered efficiency such as there is with most other machines during the wearing-out stage; often there is no obvious indication of deterioration until the fall occurs. A careful and thorough inspection is the only method of detecting worn cable. That is why inspections should be made frequently and the requirements made apparently stiff.

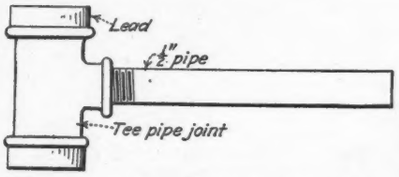
The factor of safety of cables is high, if they are put in according to approved codes. The breakage of, say, 11 wires in a six-strand cable that has 19 wires per strand is not necessarily dangerous; the factor of safety is merely reduced from 5 to 4.4, or an approximately similar amount from some other factor of safety in the beginning. What does render the condition dangerous is the unseen defects and what may result from the shocks of starting and stopping. Inspections may not thoroughly cover every part of the cable; there may be a section that is only visible in an almost inaccessible pent house and this may not get inspected.

This information, together with that found in a reliable code book should enable anyone in maintenance work to make adequate inspections. Conscientiousness is of primary importance. The above does not take into consideration other conditions that may be fully as risky as frayed cables. The overhead structure may be weak or loosening up, the sockets may be poorly leaded or improperly fastened, and changes in the work may have imposed greater loads on the elevator cable than were intended when it was designed.

DONALD A. HAMPSON.
Plant Superintendent,
Morgans & Wilcox Mfg. Co.,
Middletown, N. Y.

Handy Soft Hammer Made From Pipe Fittings

THE homemade soft-faced hammer shown in the accompanying sketch is nothing more than an ordinary standard-pipe T fitting and a piece of half-inch pipe. The former, when filled with



A SOFT HAMMER like this may be made in almost any desired weight.

* * * *

lead, serves as the hammer head, and the latter is the handle.

Molds for pouring are unnecessary. Simply wrap paper around the rim to form the face of the hammer and to keep the lead from spilling over when the metal is poured.

It is not necessary to fill the T entirely full of lead, just use pieces of scrap iron, cast iron, brass, or anything to fill space.

This makes an excellent hammer and it can be made in almost any desired weight because there are so many standard sizes of pipe fittings. The one shown weighed about four pounds.

A soft lead or babbitt face is unbeatable for striking and driving bolts, nuts, shafts, and similar machine parts that must not be scratched or battered.

Newark, N. J. S. F. WILSON.

Cutting Out Motor Coils Preferred to Rewinding

IN A PREVIOUS issue of Industrial Engineering there was an item on "Cutting Out Coils in Emergency Repairs to A.C. Motors," and as I have practiced cutting out coils on all my motors, both a.c. and d.c. for a number of years, not only as an emergency but as a permanent job or until further trouble developed, I am of the opinion that my experience would be of help to some other reader.

Several years ago lightning ruptured seven coils in a 200-hp. 2,200-volt, 60-cycle G.E. synchronous motor that was driving an Ingersoll-Rand imperial-type air compressor.

This was the only compressor we had and the plant was dependent upon it. Several electricians told me it was impossible to cut out coils on a synchronous motor, but as I had cut out coils on all other kinds of motors, I could not see why I could not do the same with this motor.

After taking out the rotor I found there were seven coils damaged, three of which had to be cut out completely as they were beyond patching, two in one group and one in another group. There were four coils per group. In addition I raised four other coils, patched and reinsulated them, and this motor ran for over two years without any noticeable difference in the efficiency. Inasmuch as we have an ammeter, a power factor meter, and a voltmeter on the board of this motor, my conclusions are that cutting out these coils made no difference in the meter readings either.

I also cut out a coil in a 25-hp., d.c. motor, that ran for 25 years.

Years ago we used more cut mica for insulation than we do today, and then we would scratch the winders name and date on the mica that we place inside of winding and under the bands. Last year a winder told me that he had rewound this armature with one coil cut out, and when he cut the bands he found the mica with my name on it with the date 1902.

I had another 2,200 volt 500-hp. slip-ring motor driving the rolls in a bar mill rolling steel. There was a flood, and the motors got soaked.

After drying out this motor until it showed no ground with a test light we started up and two coils burned out which we cut out. This motor kept burning out coils from time to time and I would cut them out until I had 13 coils less. Two entire groups were cut out and the motor ran two years in this condition and was apparently as good as new. We then rewound it when the mill was down for two weeks.

We have over 200 d.c. and a.c. motors which have been running over three years and of these we have only rewound three motors and cut out coils on four motors.

Some electricians don't agree with me about cutting out coils, although I have cut out hundreds of coils and have never been able to see where it has seriously interfered with the efficiency of the motor. One certainly saves labor and material, and I think you have a better job with one or two coils cut out than you would to rewind it at the time, because the other coils have had a thorough test in the run, whereas if you rewind it the new winding probably would not be insulated as good as the old one.

W. D. WILSON.
Birmingham, Ala.

Tractor-Trailer Trains Afford

A Flexible System for

By E. J. TOURNIER

Estimate Engineer
Robins Conveying Belt Company
New York, N. Y.

THE USE of conveying systems for transferring commodities from one part of a plant to another, whether these systems be railroad tracks, mechanical conveyors, or overhead cranes, establishes definite and inflexible paths of travel. It happens then, in many cases, that the plant layout is subordinated to the machines. This, in certain industrial processes is right and proper, as for example in progressive assemblies or other continuous operations. It is a principle that is not universally applicable, however, since no one type of mechanical handling equipment can serve for all classes of work.

Attempts are made, from time to time, to install a single form of equipment for handling all kinds of commodities, without analyzing the various processes of the plant; by which method, alone, the proper function of materials handling facilities may be determined. Some of these will be found to be continuous, in well defined paths, and so will be best served by permanently fixed equipment. Other functions will require flexibility both in the means of transport and in their channels of movement. The transfer of materials from one building to another, at irregular intervals, is an instance of the sort referred to.

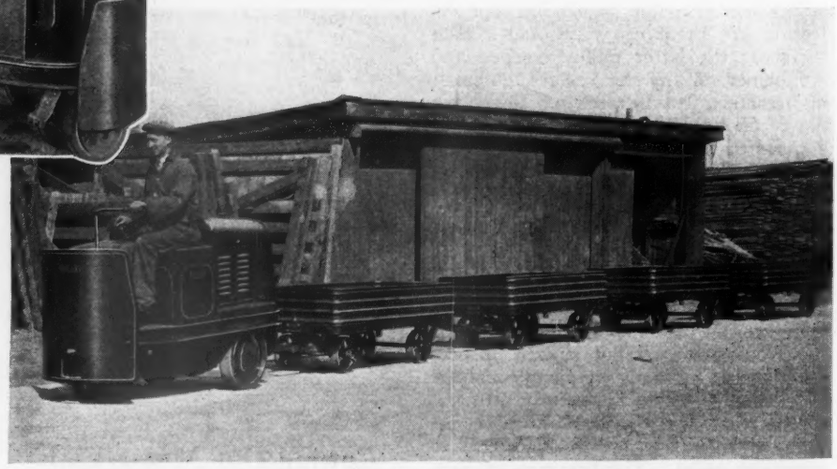
The restrictions sometimes imposed by straight line systems of transportation when something better is available, is illustrated by the use of spur tracks in manufacturing plants. In the vicinity of large cities, desirable industrial sites are not excessively high priced at one dollar per square foot, but if an unduly large proportion of the area is taken up by the spur track right-of-way, the latter is an unreasonably expensive conveyor. As an example, on a plant 300 x 1,000 ft. the spur, including curves, will require 200 x 300 ft. which is equivalent to $60,000.

Even if the cost were half this sum, it would be excessive, leaving out of consideration the fact that the receiving and shipping departments as well as the power plant must be located on the spur track. And these must all be located so, whether or not it is the best place for them. Economically, it might be that some of them should be in other locations.

The motor truck has freed many industries from these restrictions imposed by railroad frontage. Cheaper sites can be purchased at a distance from the railroad and these are perhaps more advantageously located with respect to labor supply, paved roads, water, gas and electric power. In addition, near smaller population centers they may be more pleasant places to work in, a condition which reflects itself in low labor turn-over.

Aside from keeping the various processes of an industrial plant supplied with parts, there are materials to be handled which are located at points remote from the fixed paths of conveyor travel. In addition, the latter, being in services of production, are carrying their rated loads, if they are being used economically. Therefore, what may be termed the extra-service work must be performed by other equipment with more freedom.

A TRACTOR TRAILER combination cannot be expected to turn around on the point of a needle; but, given room to work in, it will do the work of five or more men with hand trucks.



THESE corrugated steel box bodied trailers are used in handling small castings to the annealing room in a large foundry.

Handling Material

NOT ONLY FLEXIBILITY, but versatility, characterizes the tractor-trailer idea. Here, a load of packing cases is being taken to the packing department.

WHERE STRAIGHT-LINE conveying is impractical, the storage battery tractor, with its ability to maneuver, affords an economical solution.

In the storage of castings, handling lumber in trim mills, in warehouses and for handling miscellaneous freight, the use of a storage-battery tractor with a train of trailers, is a familiar example of self-propelled handling machine. This method is open to the objection that it requires space for maneuvering, and attempts to use it where space was too limited have been unsuccessful in some instances.

This system of trackless transportation, like most others, has been tried out without regard to its reasonable limitations, and has sometimes been judged unfavorably because it did not accomplish the impossible. It is obvious that a motor unit of any kind towing three or four wheeled vehicles loosely coupled together, cannot be expected to turn around on the point of a needle. It requires some space and if given that space, it will operate to complete satisfaction and do the work of more than five men, as an alternative to hand operated trucks.

In a lumber or trim mill, the electric tractor can handle almost any specially designed trailer. It can draw three or four buggies of lumber from the cars to the open air piles, the air-drying sheds or directly to the dry kilns. It can take the entire load of the average kiln to the wood shop and the dressed timber from the wood shop to the carpenter-shop storage.

In the foundry, it can take the day's casting to the storage yard or the casting house. All it requires is a solid pavement upon which to operate. The type of trailer truck makes little difference. It may be a flat car for large castings or a side dump car for small ones. As compared to the common method of piling all kinds of castings on a platform truck on a narrow gauge track, the trailer system will cut the handling cost almost in two.

The extra-service work, to which reference has been made, requires equipment which embodies two essential principles of materials handling. The first of these is that economical operation requires unit loads to be the maximum practicable. The second is that the handling equipment shall be capable of picking up the load wherever it may be. These two principles combined provide maximum efficiency and flexibility. Storage battery tractors and trailers exactly meet the specification, and for that reason they are successfully applied where straight line conveying is not suitable.

As an example of inter-department haulage using the trailer, the plant of a manufacturer of well known automobile engines is of interest because of the results accomplished.

The factory consists of a foundry, machine shops and assembly buildings, extending on a radius of about 300 yards, all connected with concrete driveways. In producing 1,500 motors daily a great deal of material must be handled from one department to another. Formerly, requisitions on other departments for materials were handled by men from the departments requiring the materials, so that the time and production loss were a very large item.

These losses were eliminated by placing two tractors, each with a trailer on a regular time schedule, calling for and delivering requisitions to all departments. In handling motors from the machine shop to the assembly plant, a haul of about 100 yards, the work is done by one man

operating a tractor and seven three-ton trailers.

The trailers are loaded either directly from the machines or by three loaders in the machine shop, and are unloaded by four men into the stock room or onto gravity roller conveyors at the assembly plant. As a rule two trailers are run in a train and 7½ tons of parts are hauled in an hour in three trips. The cost of operating the trailers and tractors, including fixed charges, amounts to $1.22 per hour, or 16 cents per ton of parts transported. It would require at least 10 men at a cost of $5.50 an hour to do the same work with hand trucks or other manually operated equipment. The savings, therefore, with the new equipment amount to $39 daily, based on 9 hours' work, or nearly $12,000 a year. This represents a 400 per cent annual return on the investment in tractor and trailers.

Another combination of self-propelled materials handling machine is that of an electric tractor and semi-trailers used by an automobile radiator factory. The many units which make up the factory are located in several buildings, some of which are near the main building, and others on adjacent city blocks. The box factory is located across the street from the packing department and the nickel plating plant is three blocks away from the main unit. Freight stations are comparatively close at hand, the farthest being about one mile distant from the shipping and receiving departments.

To pick up incoming raw materials, to deliver boxes to the packing department, to haul radiator shells to and from the nickel plating plant and, finally, to haul finished radiators to the freight stations, requires an extensive equipment of dependable transportation units. Uninterrupted service is essential, particularly for interdepartment hauls, where a delay in the delivery of boxes or of plated radiators might seriously restrict production.

Until two years ago this plant used a fleet of two-ton to five-ton trucks, but found them expensive to operate and maintain. More truck time was spent in loading than on the road. Two years ago the trucks were replaced by semi-trailers and a 2½-ton tractor. The latter was a regular truck chassis to which was fitted a fifth wheel for supporting the front end of the semi-trailer. These units are still used in hauling finished radiators to the freight station, and do as much work in nine hours as three two-ton trucks formerly accomplished in the same time.

Each of the semi-trailers has a capacity of 3 to 4 tons and is equipped with a platform stake body. While one semi-trailer is being loaded a second one is on the way to the freight station, and the third is being unloaded. One tractor with two semi-trailers handles 20 loads of radiators in a 9-hour day and has handled as much as one load every ten minutes, which is at the rate of 54 loads per day. An average load of radiators weighs 3,350 pounds, and consists of about 18 crates.

It is of interest to note that a few months ago one of the tractors was in the repair shop, and during that time a two-ton truck was used in its place. The truck was double decked, which permitted carrying a load of 30 crates. But the best the truck was able to do was 6 loads in 10 hours, which is considerably less than was accomplished formely by the trailer system.

However, it should be stated that the comparison is not strictly correct because motor truck haulage is most economical on long, uninterrupted runs, whereas the tractor-trailer combination can be used only on comparatively short trips, for which it is especially designed.

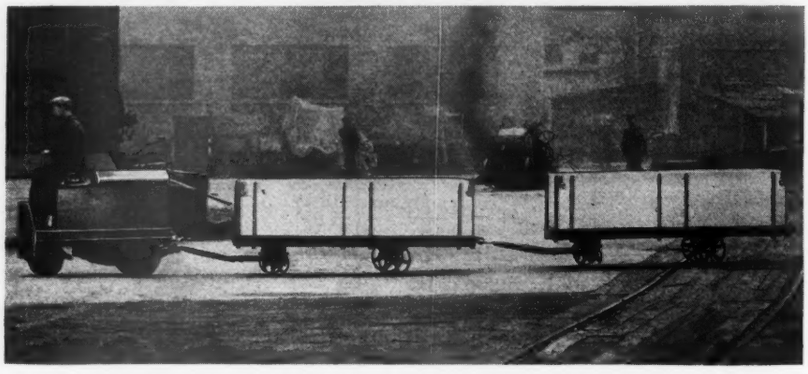
On the assumption that both the tractor and the truck were equalized as to the average haul, it could still be shown that the advantage lies with the tractor and semi-trailers. This is so because in the latter system the motor unit is detachable from the load carrying element, which allows the carrier to be idle for loading or unloading; meanwhile, during the non-productive period of the trailer, the power unit is employed at other work. By contrast, the motor truck must necessarily be idle while the load is being put on or taken off the truck. Also, because of its construction, the truck can carry much less than the tractor can pull, in the ratio of two or three to one.

On each load of crates the use of tractors and semi-trailers showed a saving of 70 cents, which is equivalent to a reduction in handling cost of 55 per cent. The semi-trailers are simple in construction, with few parts; they are therefore inexpensive to operate. The principal items of cost are repairs and depreciation, and the former is a small amount because there are practically few wearing parts.

Operation of the semi-trailer, also, is a simple matter. Coupling and uncoupling are accomplished without the driver leaving his cab. To couple, he has only to back up to the semi-trailer, the guide wheels center the coupling with the fifth wheel on the tractor, and the coupling locks automatically. In uncoupling, the driver has only to pull a lever in the cab and drive away. The front wheels of the trailer drop, which sets the brakes; inversely the action of coupling releases the brakes and raises the front wheels.

The case just cited is an excellent direct comparison of the right and wrong application of materials handling equipment, which is a condition seldom found in a single plant. Usually losses due to wrong selection remain among the so-called "hidden losses."

However, in the instance under consideration the fallacy of keeping an expensive power unit idle during loading and unloading, was discovered, and the proper substitution made.



A TRACTOR-TRAILER combination serving one of the large automobile plants. The box bodies on these trailers are so made that both ends and sides are demountable.

Rearranging
POWER CABLES
With the aid of a model of the Layout

By R. F. KNEELAND
Boston, Mass.

IN REVAMPING the underground distribution cable system of a large plant, in order to straighten out a poor installation, we adopted some methods that may be of help to others who have a similar problem to solve.

In this plant, which has a generating capacity of 4,500 kva., 2,300 volts, three phase, the cables left the main building through a duct line at each end of the basement, a subway at one end, and two duct lines at right angles to the length of the basement. This arrangement is shown in Fig. 1*A*. The situation was further complicated, however, by the fact that some of the cables from one end of the switchboard left from the other end of the basement. This resulted in a jumbled mass of cables beneath the board that was not only unsightly, but a real hazard, inasmuch as trouble on one cable might spread to others and tie up the whole plant.

As will be seen from Fig. 1*A*, there was a subway at each end of the basement. The subway at the west end was fitted with wooden shelves supported by steel brackets for carrying electric cables. It would probably have been better if in the original layout the subway had been made to extend across the front of the building and been tied in with the east-end subway by duct openings through the basement wall at frequent intervals to allow the cable to drop directly from the switchboard and then pass out through the wall. However, for some reason this was not done.

There were two reasons for not extending this subway when the matter was recently taken up: (1) The cost would have been excessive; (2) the east-end subway was not equipped with shelves for carrying electric cables and the cost of rearranging the pipe lines in this subway to make room for cables would have been excessive.

Eventually, the arrangement shown in Figs. 1*B* and *C* was adopted, although two serious obstacles were encountered in carrying it out. In the first place, the foundations under the building columns must not be disturbed. Second, it was not permissible to alter or disturb the east-end subway. Therefore, the ducts were carried through the basement wall in groups of eight. Four of these groups turned east and four turned west.

When the duct lines going east approached the east-end subway, they were pitched up slightly and spread out so as to be only two rows deep over the subway roof. The sidewalk

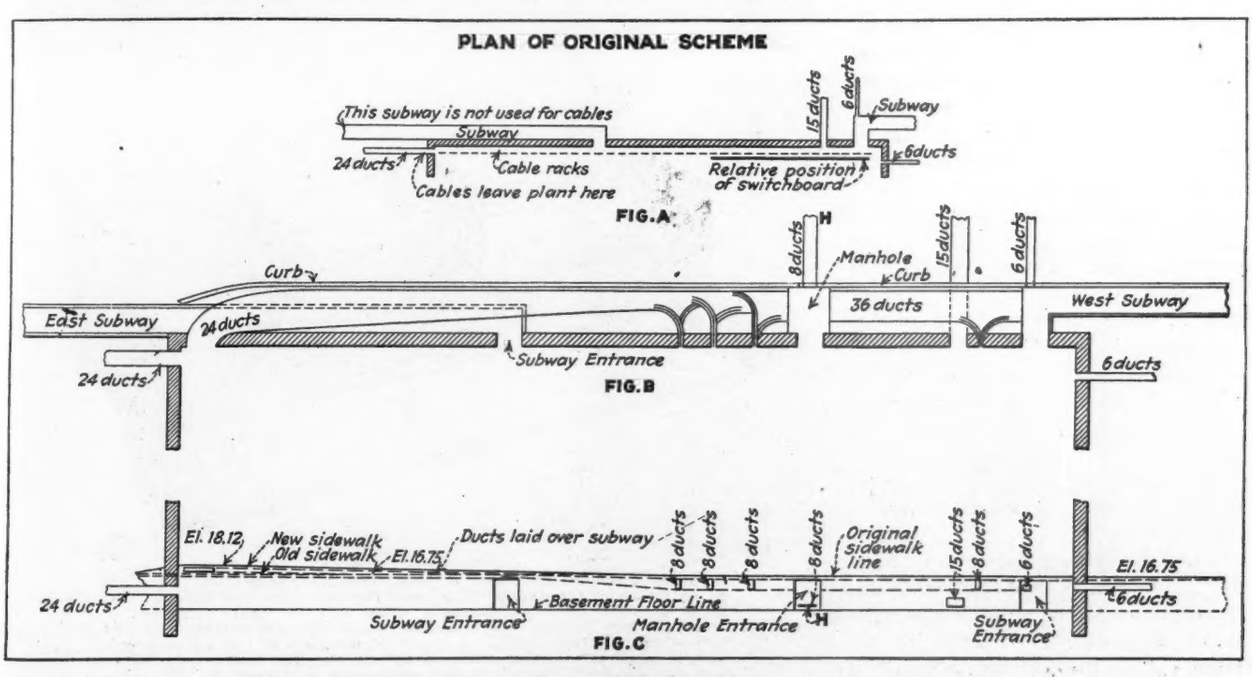


FIG. 1—THE ORIGINAL arrangement of the cable ducts is shown in *A*. Sketches *B* and *C* show the plan and elevation view of the new layout.

which was over the subway and close to the building was graded up as indicated in Fig. *C*. This change in the elevation of the sidewalk has not caused appreciable inconvenience to anyone and is not so unsightly as might be imagined. A new duct line, *H*, was also provided.

To facilitate the changing of the cables, the model shown in Fig. 2 was devised by the writer. Inasmuch as the circuits supply 2,300-volt service, for the most part, every precaution was taken to protect the men and prevent any misunderstanding in regard to the identity of the different cables and their proper position.

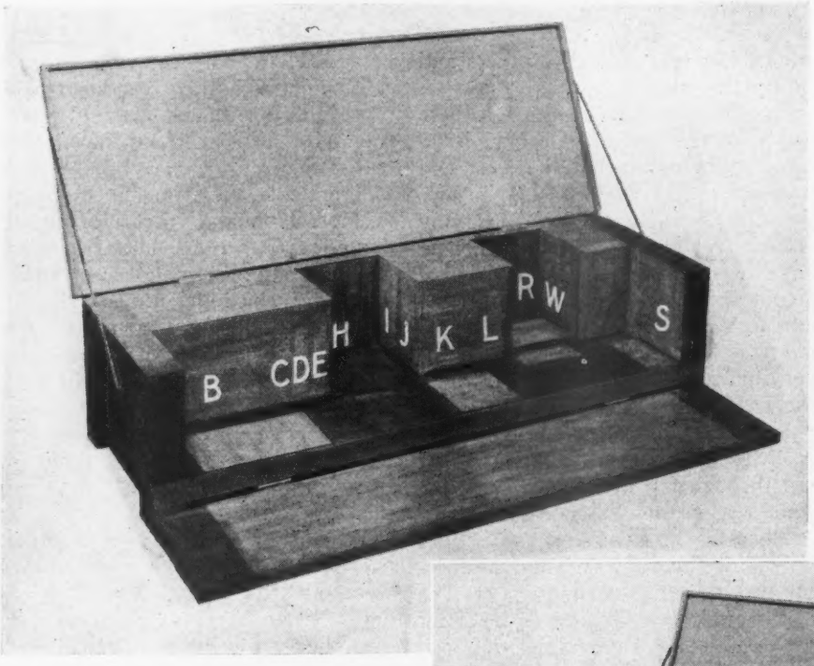
The two ends of the model represent the end walls of the plant basement and each has a diagram of the duct lines leading therefrom drawn on it. The face of the model, where the group letters *B, C, D, E, K* and *L* appear, represents the front wall of the plant basement, although it is not made to scale. Under these letters are diagrams showing the number and arrangement of the ducts in that location.

The bay where the group letters *F, G, H, I* and *J* appear represents the manhole built just outside the basement wall; this manhole has a large opening through the wall, which gives it the practical effect of having three sides.

The bay where the group letters *M, N, R* and *W* appear, represents the entrance to the subway that runs under the sidewalk, parallel to the front wall of the building, although it does not pass the front of the building.

The inside of the cover of the model carries a blueprint diagram of the switchboard panels. These are numbered from 1 to 32. Back of each panel the relative position of the cables coming through the floor is shown and a note gives the destination, original size and proposed size of each cable. A line in front of the panels indicates a cable and is marked first with the destination of the cable and the routes to be followed in the new arrangement. This route is given by the duct group letter and particular duct number for each point where the cable enters or leaves a duct line. The vertical faces of the model, representing the walls of the basement manhole or subway, have the different groups of ducts designated by a letter. The groups where cables leave the plant are accompanied by lists giving the duct numbers, the sizes of cables and their destination.

The cable men found this model to be of great help in their work and would have had considerable trouble in rearranging these cables without a layout that could easily be visualized.



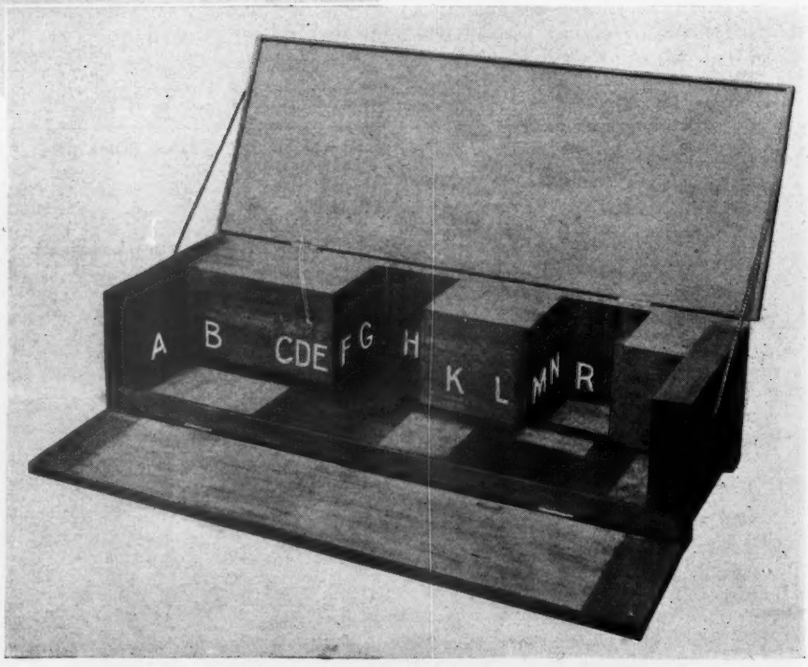
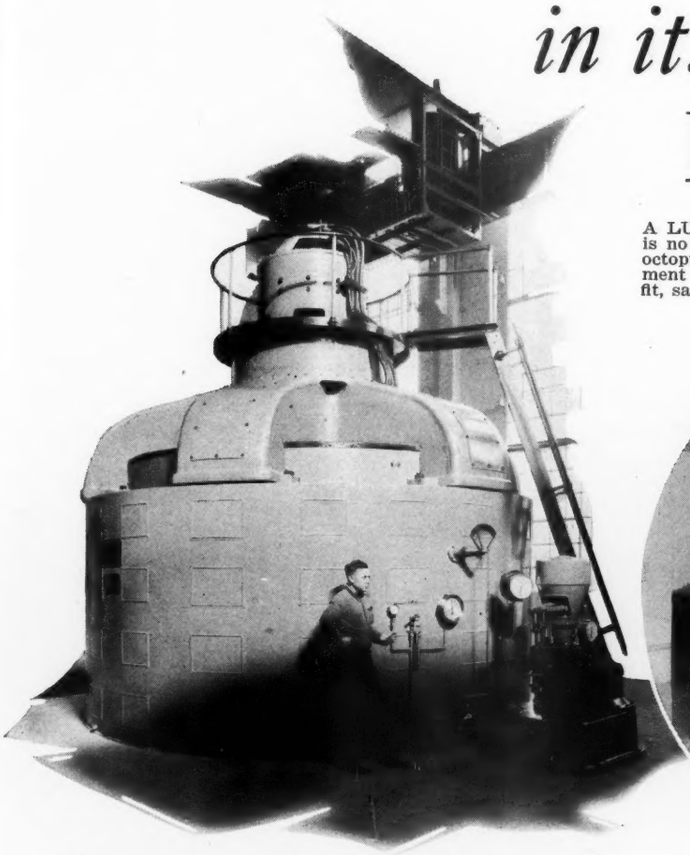


FIG. 2—THIS MODEL of the plant basement simplified the work of rearranging the cables. The ends represent the end walls of the basement and the two recesses, from left to right, represent a manhole just outside the basement wall, and the entrance to the east subway, respectively. A complete diagram of the switchboard panels is pasted on the inside of the cover. The number, location, and arrangement of all cables and ducts is shown by diagrams on the portions representing the basement walls (marked B, C, D, E, K, L) and on the bottom of the model.

How to Calculate Illumination From a Bare Lamp

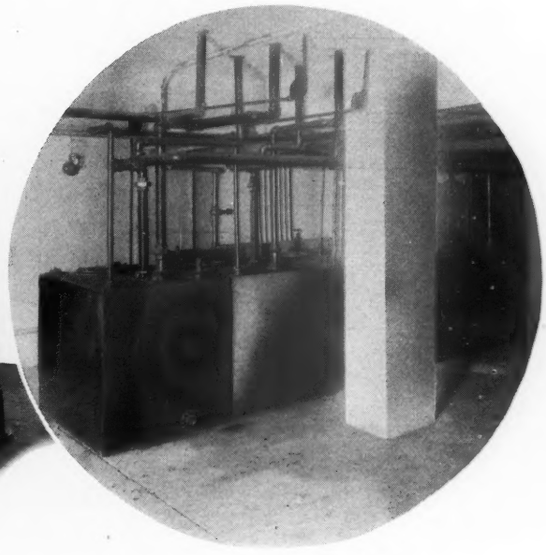
THE INTENSITY of illumination upon any working plane is measured in foot-candles. If a lamp gives 16 c.p. in a downward direction, and a table is placed under the lamp, at a distance of 1 ft., the illumination over an area of 1 sq.ft. would be 16 foot-candles. A simple rule for calculating the illumination from a bare lamp on a surface immediately below it is: divide the candlepower of the lamp by the distance from the surface squared. For example: the illumination from a 20-c.p. lamp suspended 5 ft. above a table (vertically), will be $20 \div 5 \times 5$ or 0.8 foot candle.

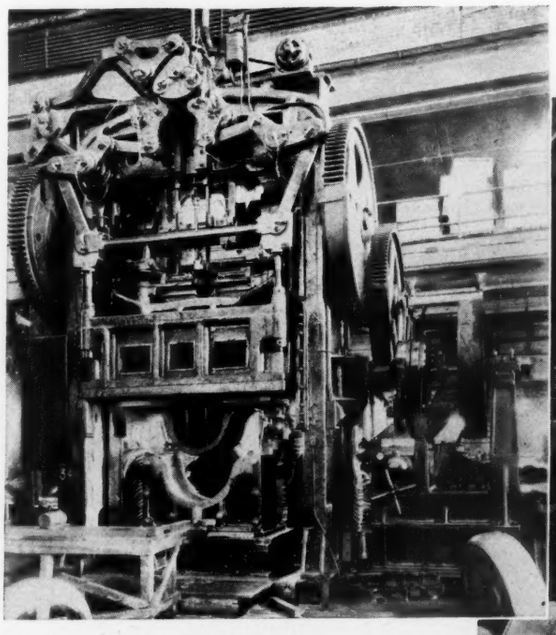
LUBRICATION *Pays its Way in its* SERVICE *to* PRODUCTION



PONDEROUS MASSES on vertical shafts as in steam turbine, and water-wheel generators float on a cushion or film of oil in the lower thrust bearing. Here, the resistance to motion is almost negligible.

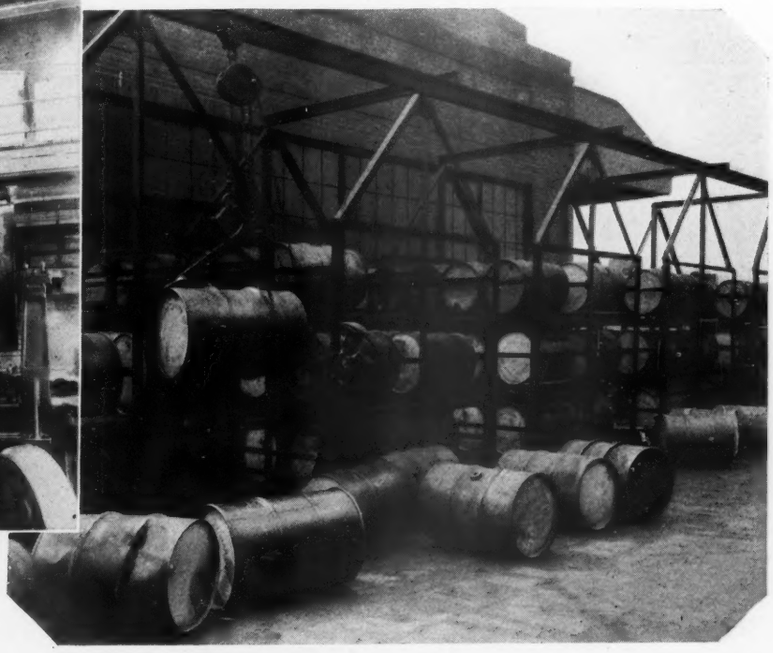
A LUBRICANT in the plant at the point of distribution is no better than its container. Open vessels attract the octopus of waste and contamination. These sealed, basement storage tanks in addition to keeping the lubrication fit, save valuable floor space.

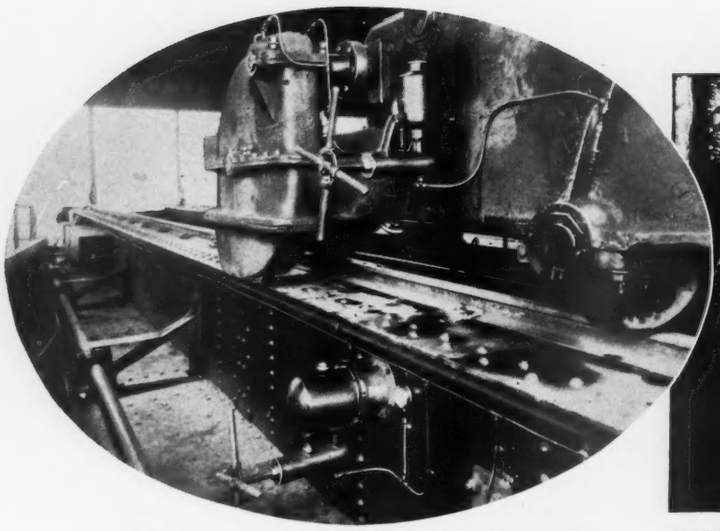




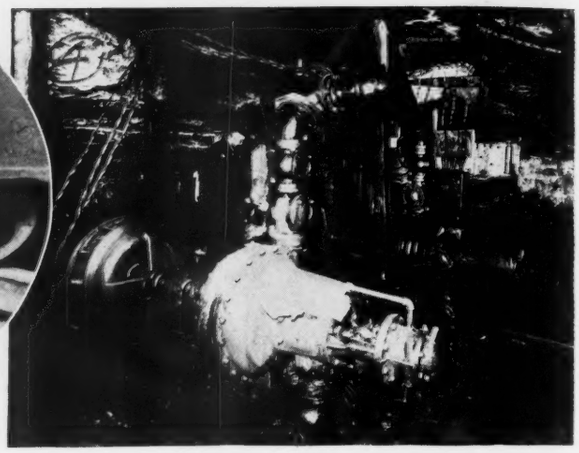
SPIDER-LIKE THREADS of pipe carry lubrication to 142 points on this toggle press, serving all bearings, gears, clutches and guides, thereby saving the time of the man with the ladder and a daily shut down of one hour out of every twenty-four that it is in operation.

WHEN YOU SEE storage facilities like this you know that someone at this gear and axle plant is lubrication conscious. There is no fussing for a certain grade when you can walk between the racks and read the labels on the drums.

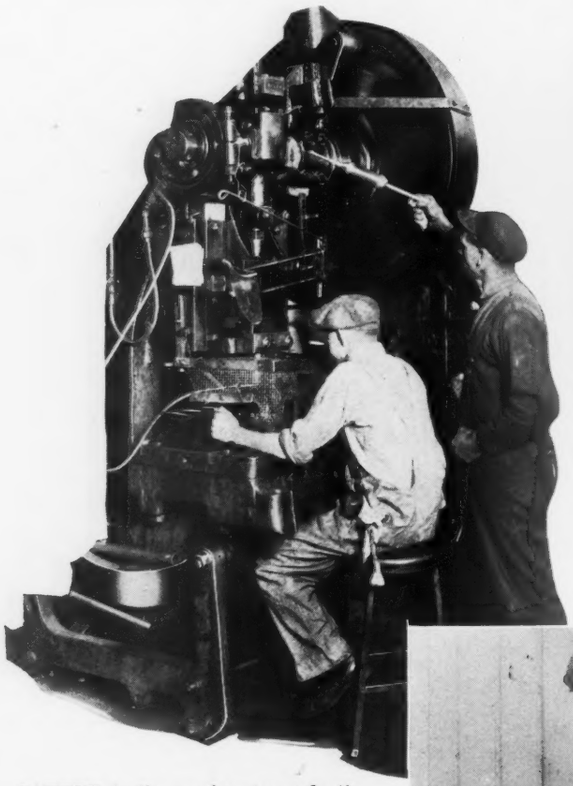




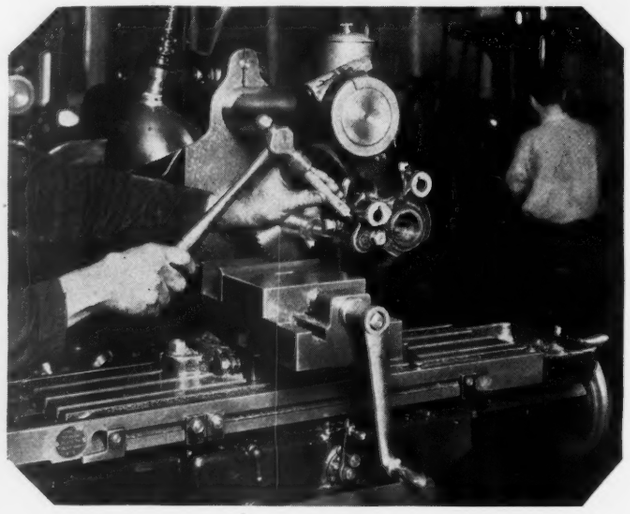
TWO MINUTES TO GO with a twist of the spokes and 43 points are lubricated on the 50-ton, 80-ft. span traveling crane. Besides eliminating 90 per cent of the danger to the oiler, overtime at time and half-time pay was abandoned.



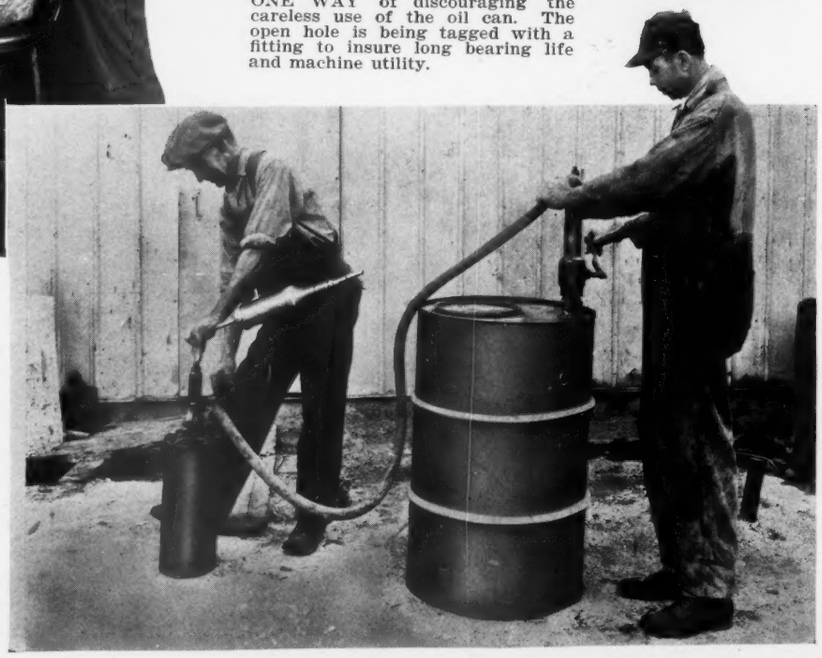
ANOTHER EXAMPLE of thrust reaction although in a horizontal plane where lubrication *sometimes* plays a part in the fight against friction. A thrust bearing (right foreground) on a centrifugal pump hundreds of feet underground.



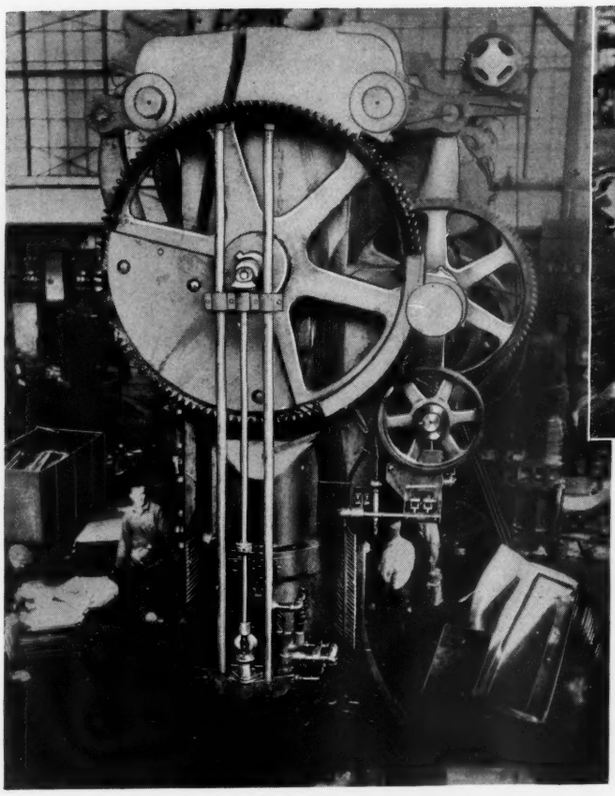
SAFETY, in the services to production is assured when the oiler can direct the lubricant to the bearings at a reasonable distance from all moving parts. This punch press now gets its lubrication on the fly.

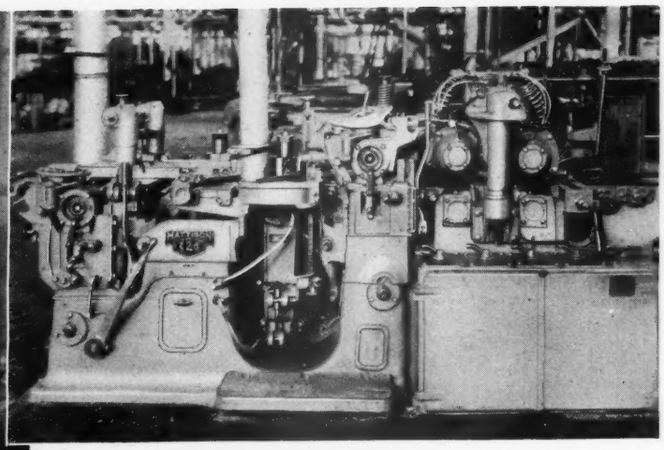


ONE WAY of discouraging the careless use of the oil can. The open hole is being tagged with a fitting to insure long bearing life and machine utility.



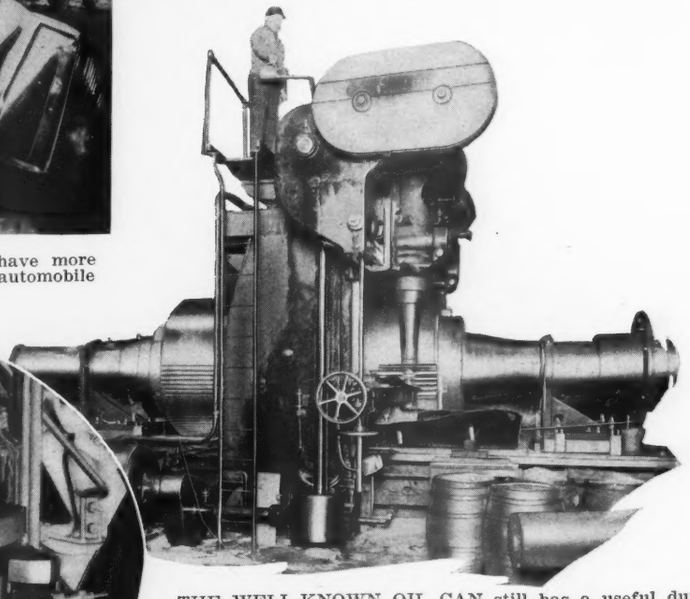
THE FINAL SCENE of this oil room sketch takes place at the bearing. The passage of the lubricant is completely sealed from the original barrel to the gun by way of the compressor in the walnut veneer mill of the Penrod Jurden-Clark Company.

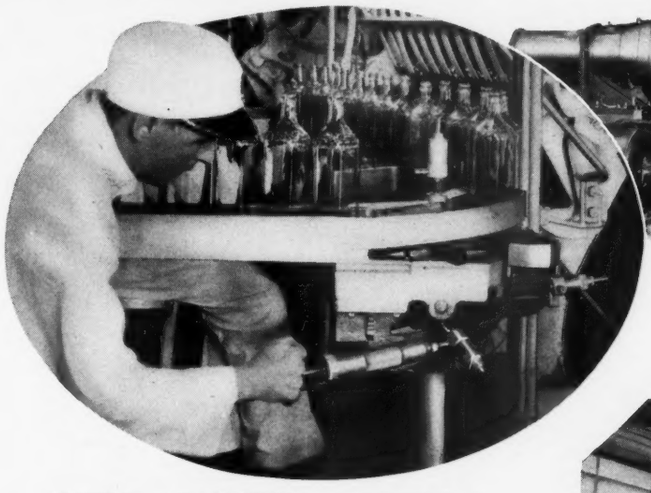




INACCESSIBILITY is no longer an excuse for burned out bearings due to lack of lubrication. The flexible conduits in the foreground terminate at the bearings that as far as lubrication is concerned may otherwise be out of mind since they are out of sight.

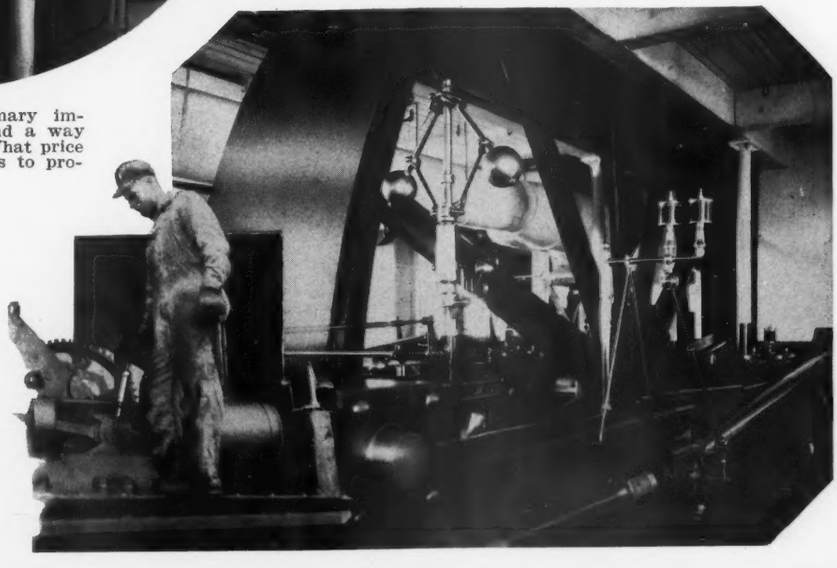
SPEEDING UP LUBRICATION that we may have more speed is emphasized by the huge press in an automobile plant shown here.





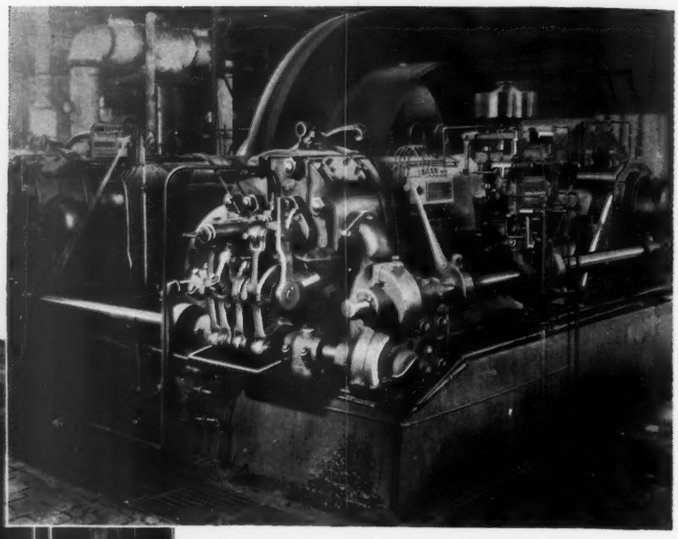
THE WELL-KNOWN OIL CAN still has a useful duty to perform where the requirements indicate liquid lubrication. Although effective enough for the purpose it savors of antiquity in the light of present-day methods.

WHERE CLEANLINESS is of primary importance, the lubrication engineers find a way to combat the evils of lubrication. "What price sanitation" is apparent in the services to production at the Moxie plant.

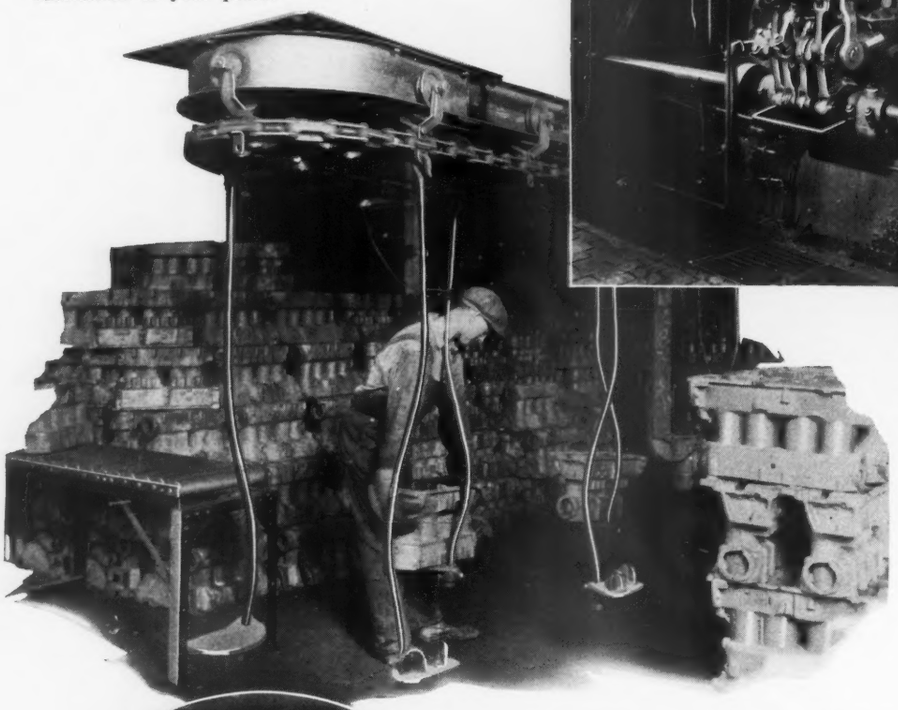


RECIPROCATING PARTS in this and the adjacent view to the right get theirs in fluid and semi-fluid form. The indoor mill engines in a warm atmosphere receive almost constant lubrication whereas the steam shovel engine in varying temperatures gets a supply during idle periods. Lubrication to be efficient must be effective in all weather.

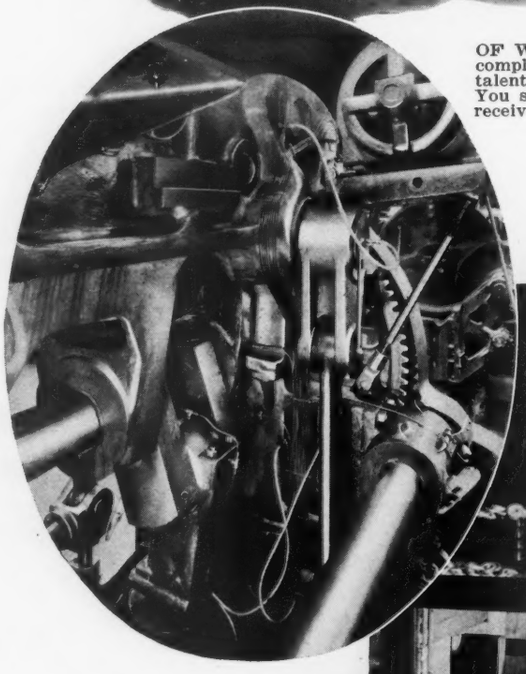
WHERE FRICTION takes its toll in power and gives nothing in return. Steel engine castings are being conveyed from the foundry to temporary storage on this overhead conveyor, whose drive motor simply overcomes rolling friction. How much power can you save with lubrication in your plant?



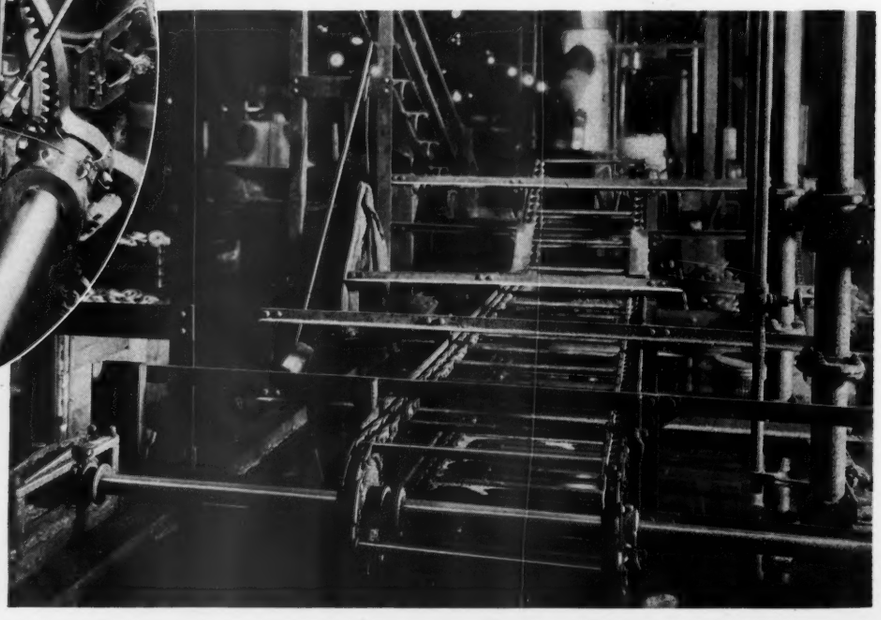
INTERNAL LUBRICATION on this compressor is regulated by the speed. The automatic oilers are cam driven from the rotating side and end shafts. Economy is assured at any speed.



OF WHAT USE is man's ingenuity to create and build complicated machines such as this unless that same talent can be applied to lubricate it without interruption? You see here, how the working parts of this giant press receive their share of the lubricant when in service.



HIGH MAINTENANCE costs are anticipated in installations such as this because of the impracticability of the results to be obtained. In most cases lubricants are a deterent to the many coating solutions applied mechanically.



INDUSTRIAL ENGINEERING
with which is consolidated
INDUSTRY ILLUSTRATED
Electrical, Mechanical and Plant Service in Industry
Published by the McGraw-Shaw Company

New York, December, 1928

Industry Can Help Aviation by Marking Roofs

ALL industry will benefit from a successful commercial air transportation system. It is fitting, therefore, that industrial plants should accede to the roof-marking request made by the Daniel Guggenheim Fund for the Promotion of Aeronautics and backed by the departments of War, Navy, and Commerce.

In substance, the request is that towns with populations between 1,000 and 50,000 letter the name of the town and mark the direction North on the roof of a large building. The postmasters of these towns are asked to take the initiative in seeing that their communities are identified.

As a rule, industrial buildings have the largest roofs and are most suitably located. It is urged that the plants served by *Industrial Engineering* cooperate in this movement toward making the airplane of greater practical utility. Details concerning the selection of buildings, size of letters, kind of paint, and so on, may be secured from the local postmaster or from the Fund, 598 Madison Avenue, New York City.

Keeping Up with Power Transmission Developments

THERE have been decided stirrings in the field of power transmission during the past year or two. Not only have manufacturers been busy developing better and more efficient equipment, but they have been very much on the job with an educational campaign to awaken industrial executives to the importance of power transmission economies in the general scheme of things.

We know that a number of our plant engineer readers have felt this quickened interest on the part of the powers-that-be, and are preparing to meet it. They are going over their power transmission layouts with a fine-tooth comb: first, to find out exactly where they stand, in the light of up-to-date practice; second, to be ready with recommendations for improvement.

There is a great deal of information—and misinformation—available on the subject of mechanical power transmission. Most of the practical, useful information, though, is scattered among dozens of sources, where it is hard for any man to dig it out and bring it together in usable form.

William Staniar, for 23 years with the Engineering Division of E. I. du Pont de Nemours and Company, has undertaken exactly that job.

Mr. Staniar, beside being consulting transmission editor for *Industrial Engineering,* is in charge of belting and mechanical power transmission in all the plants of the du Pont Company. He has devoted the past fifteen years to intensive study and practice in this particular field, and his work for both the du Pont and the General Motors plants is well known.

In a series of articles which will appear in *Industrial Engineering,* Mr. Staniar is bringing together, for the benefit of our readers, all the scattered data on up-to-the-minute equipment and practice; correlating this and interpreting it in the light of his own practical experience of more than fifteen years as a power transmission specialist.

The series will begin in our next—January—issue, and will continue through consecutive issues of *Industrial Engineering* during the year 1929.

Why Subordinate Lighting to Other Production Tools?

A MAN cannot do good work with poor tools. Lighting, someone has said, is more than providing light, it is a tool of production, the value of which is not measured in terms of production costs but in the facility to see quickly, accurately, safely and comfortably.

Electric lighting is but an effect, the cause of which is the application of electrical energy to a circuit consisting of conductors, switches and electric lamps. The effect may be good, bad or indifferent, according to the methods adopted for its control.

In the early days, a lamp was considered merely as a source of light and no attention was paid to the elimination of glare, shadows, to the essentials of height and spacing or to the necessity for careful consideration in the choice of reflecting or diffusing equipment. All of which contributed to the many inefficient installations in existence today that tend to handicap not only the production worker but the maintenance department as well.

Intensities of illumination, in use and recommended at present, in many instances are far below those that are indicated as desirable. In fact they are entirely out of proportion to the steadily decreasing cost of light. Also, at the present low levels of illumination, a reduction in the amount of light through inadequate maintenance means less work done, increased spoilage, more accidents, eyefatigue, eye strain and less cheerful surroundings.

The SPECIAL

Widens the Field

By G. E. SQUIER

WE WILL assume that every factory and production manager knows what elevating trucks are. In fact, we will assume further that he is using them, if he has considered them practicable for the handling of his materials.

Many times, however, what might prove to be a very profitable use for lift trucks is rejected for lack either of sufficient understanding or imagination, or both, as to the almost unlimited possibilities of platform construction. Platforms are being made today to handle almost every conceivable load that has to be moved over the floor in the modern factory.

FIG. 1—A SPECIAL platform construction, evolved for use in a factory employing both electric and hand lift trucks. The hand truck picks these up the long way, while the electric can handle two at a time, the short way, across the platform.

FIG. 2—A SPECIAL waste box built on a lift truck platform. The box door is hinged, in two sections, making it easy to load or unload the scrap.

Even capacity has practically ceased to be a factor in their applications.

It is to open up this line of thought that this article is being written. No more than a few illustrations can be shown, but these will show that study and ingenuity pay well and they will also suggest that your own special handling problems can probably be solved just as these were solved—by calling in the well known specialist, Old Doctor Imagination.

Picture, if you can, how comparatively limited would be the use of motor trucks if only one or two body types were available. How about handling coal, oil, plate glass, bottled pop and scores of other products for the handling of which special types of bodies have been built to cut down handling costs, to save waste and breakage or both.

Exactly the same relation between truck and body exists within the factory in the case of the elevating truck and the platforms which are, or could be, used with it. There is one difference, however, which is all in favor of the flat platform system.

Because the units are smaller and less expensive, a far greater diversity can be attained. And remember that in the factory the "chassis" or lift truck in this case, is removable and can be used interchangeably with a dozen different types of platforms if it is desired.

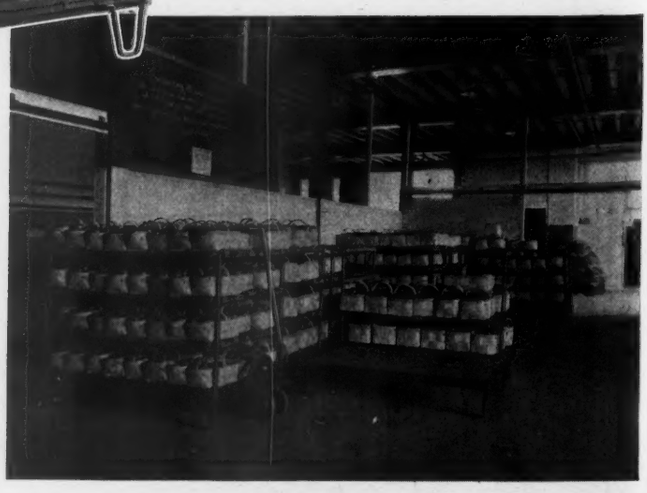
I have been in factory after factory where lift trucks were in use in a single department, for example, and where they were liked very much. However, they were only fractionally productive, for by a little study and the building of some different types of platforms the same lift trucks could be made to carry their savings into several other departments. A walk through your factory with this thought in mind might prove very profitable.

The word "platform" as used in this article is meant to include racks, containers or any special device which may be mounted on or built into the supporting platform under which the lift truck is inserted to pick up the load.

To note recent progress in platform design and construction you have only to look back a few years to the first all wood platforms which

* * * *

FIG. 3—BY ATTACHING sockets to a flat type platform, the use of removable end pieces provides a three-way convertible platform: flat, with end racks, or with tiered shelves.



L PLATFORM

d of the Lift Truck

consisted merely of a flooring supported by two uprights between which the elevating truck was operated. The platform system itself only goes back about twenty years. It is only within the last few years that its greater possibilities have begun to be realized, to which realization nothing has added more than the designing and constructing of special platforms. The lift truck is worthless unless the load can be properly supported.

By all means consider the platform first in any special handling problem, in fact in any lift truck problem. If the platform to hold the load can be worked out it is safe to say that a lift truck either of standard specifications or with special features can be furnished to handle the platforms.

Remarkable advances have been made recently in the design and construction of special purpose platforms both by platform manufacturers and by users of them. This development has come not alone through greater experience and imagination but also through the greater use of better materials.

The use of steel in combination with wood has made platforms stronger and lighter and has multiplied many times the length of service. It has further made possible many designs which could not otherwise be made. Welding is a new tool in the hands of the platform maker and he is cutting down costs and making some wonderful platforms with its aid. The pressed steel platform, with its many possible variations has been made to do many jobs which no other platform could do. All of these are recent developments.

Take, for instance, the special platform shown in Fig. 1. Here is a large factory using both hand and electric elevating trucks. It is apparent immediately that a platform which could be handled by either would cut handling costs very greatly. But it hadn't been done before, insofar as they knew. What of it? "Let's work it out," they said; and they did.

The clearance for the electric truck had to be 13 in. while that for the hand truck had to be 7½ in. Note how cleverly that is arranged. The hand lift truck picks up the platform the long way, under the channel irons, while the electric lift truck picks it up the short way, across the platforms; and what is more, it generally picks up two at a time. The capacity of the platforms is 5,000 pounds.

Now look at Fig. 2. No, it is not a movable safe deposit vault, but it is surely worth more than its weight in metal. It is a waste box and here is the way it is used.

Large amounts of scrap metal and wire accumulate in the plant where these are used, the removal of which has always presented a troublesome problem. They had lift trucks anyway, so it was arranged to build these metal waste boxes, mounted on platforms, and of a size which could be used with their lift trucks.

The waste is deposited in the boxes regularly; there are no piles of scrap about, no barrels to fill and the space between the machines is clear. Note that the box has a hinged door in two

FIG. 5—THIS platform was developed for use where heavy loads had to be moved down a narrow aisle, the load having to be delivered at the side. (Center).

FIG. 6—A SIMPLE and inexpensive rig that permits handling 96 meters at a time. Platforms can be adapted, in similar fashion, to a wide variety of products. (Right).

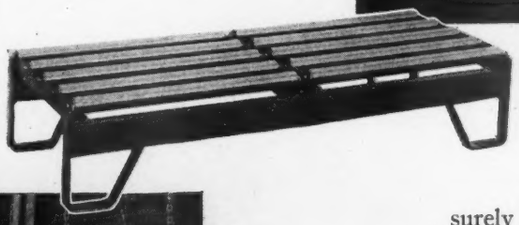


FIG. 4—A TABLE type platform of proper height immensely simplifies the charging of this hardening furnace. The same idea is applicable to a variety of handling problems. (Left).

FIG. 7—THIS PLATFORM was developed for the purpose of simplifying the handling of short lengths of pipe. It has proved highly successful.

* * * *

sections, to facilitate the removal of the scrap.

Suppose this box were on the floor? How would you move it easily? If it were mounted on casters or a wheel truck it would be a dead investment and mighty hard to move. Now, one man and a lift truck can move the box around at will, full or empty, and all that is tied up is an inexpensive platform.

It paid to dope this out, didn't it? So well did it pay that this box has become standard in the factories of this company from coast to coast. And it was an added use for the lift truck equipment which they already had.

Fig. 3 shows an ingenious development in the plant of a large fruit distributing company. It is just as applicable for factory use. That is where the imagination comes in. Their base platform is regular in every way except for the stake pockets at the four corners. On some goods they use the flat platform. Then again, as shown, they slip the end racks into the sockets and run supporting wooden frames from end to end, the result being a perfect shelf type platform. The end racks and frames are stood up in a corner when not in use. There are few factories where such a scheme would not be of value.

Often a table type platform will effect some remarkable economies where no other type would work. Fig. 4 shows such a platform, which was designed to charge the hardening furnaces in a large Western plant. This platform, because of its sub frame, can be handled by the same lift truck which is used with the regular flat type of platform. Notice how the height of the platform is made to coincide with the height of the furnace doors thus saving much lifting.

Perhaps you operate a canning factory and unless you were looking for ideas would see little of similarity between a hardening furnace and packing food products. But here is the point of this whole article. Perhaps your handling can be simplified by movable benches, for instance, or by some special platform. Probably most of the developments along this line have come from applying the other fellow's problems to your own.

Fig. 5 shows a mighty interesting development, not because it is a common platform, for it isn't, but because it solved one special problem and solved it 100 per cent.

Movement of heavy unit loads down the aisle required side delivery to be effective. So rollers were superimposed across the metal platform frame as shown and that was all there was to it. The same trucks that handle their other platforms handle these. But the big point is that the special platform and not the truck, was the solution of this problem.

If you will approach your lift truck problems from the standpoint of the platform first of all there is usually plenty of room for surprise at the economies that can be put into practice.

Take the case of handling meters, as shown in Fig. 6. Nothing wonderful about it, perhaps. It is simple enough. But this inexpensive rack on an inexpensive platform handles 96 meters at a time and handles them safely. The same truck handles other types of platforms which have been built to handle cases, flat stock and other finished products.

Pipe, even in short lengths, is awkward stuff to handle in any quantity because of its tendency to roll and because it tends to bulge and break the supports at the corners.

The platform shown in Fig. 7 was the answer and entirely eliminated the difficulties mentioned. It is all metal, has no floor because it needs none, but is welded throughout and equipped with braced stakes at the corners which will hold any load that could be put upon the rack. This man wanted to handle pipe in short lengths with lift trucks. He is doing what he wanted to do because he wasn't stumped by difficulties which were very soon eliminated by the proper rack, which, by the way, should stay put forever.

The handling of batteries in process of manufacture has always been a troublesome problem. The acids have to drain, they eat the metal and yet wood has not proved to be satisfactory. So the Old Doctor was called in and put to work in conjunction with a platform manufacturer. The result is shown in Fig. 8.

An all metal platform was built and painted throughout with an acid resisting paint to protect it. An expanded metal flooring for ventilation and drainage was welded to the frame and because the batteries were inclined to be top heavy a supporting railing was added. The results have been completely satisfactory. The same trucks that handle platforms of the regular type handle these and the problem is solved.

By use of a portable elevator designed for the job they now stack these platforms loaded with batteries in supporting racks four high. One man can put up or take down the top tier as easily as the bottom one. No factory man needs to be reminded of the tremendous economy of space

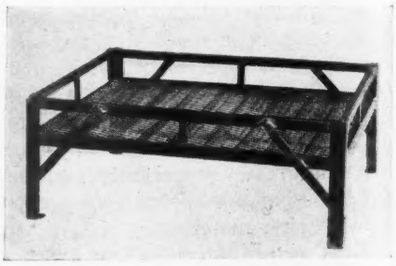


FIG. 8—STORAGE batteries in process of manufacture are not easy to handle. This platform, described in detail in the accompanying text, has solved one manufacturer's problem.

* * * *

which the proper thought and imagination applied to this problem has brought about.

The solution of the problems mentioned is nothing remarkable, nothing indeed but what the average factory man would handle just as well.

The point is that he is busy getting out the production. Details of that engage his attention from hour to hour, so that he does not feel that he has time to do a lot of things that he would like to do.

If the subject of handling materials is more or less chronic with a man he will find, unless his shop is a very unusual one, many cases where he can make his existing platform system do more work and accomplish more handling economies.

It Pays to Know

CONTROL EQUIPMENT

By H. J. BROWN
Consulting Engineer, Boston, Mass.

IN THE old shell game the winner had to be a good guesser. Not so, however, in selecting control equipment. The choice, as in this case, must depend on a thorough knowledge of the functions it must perform.

SMOOTH, gradual acceleration, is desired in many processes, particularly in the modern gypsum plant where the class and type of equipment demands a control of motive power which will give that smooth, even starting free from the "jerks and jogs" inherent in the average compensator-type starter, with which every engineer is familiar when the starter handle is in the hands of the average mill operative.

For the plant of the Atlantic Gypsum Products Company at Portsmouth, N. H., of which the writer was the engineer, it must be confessed that the use of the usual type of compensator was planned. Only by good fortune was the resistance-type starter brought to attention by one of the manufacturers who was bidding upon the motors required for the drives. The writer was unfamiliar with this particular type of control equipment which was finally selected.

From adequate experience with the conventional compensator and its ills it was but natural that the phrase "steam engine acceleration," used to describe the resistance type starter, should appeal. Where starting of motors requires definite acceleration without undue inrush current the gypsum plant has a decided need.

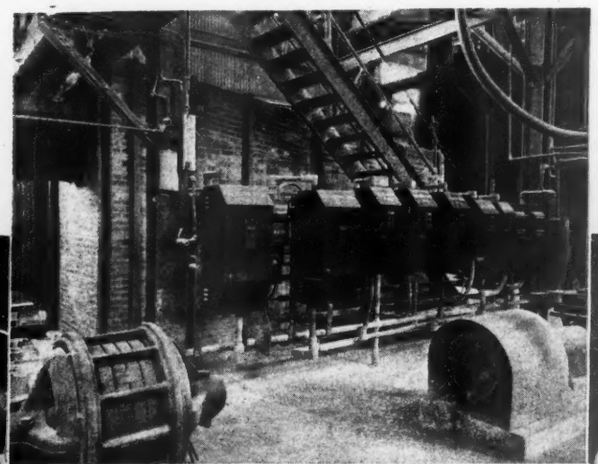
Perhaps the thing about the resistance starter which appealed most was the absence of any insulating medium in the form of oil, for in a gypsum plant, and it may be presumed that the same condition holds good in any type of plant producing pulverized materials having oil absorbing properties, the contamination of the oil in starting devices has a tendency not only to thicken the oil but to increase the wear on the contacts as well. Gypsum, moreover, is hydroscopic to a certain degree and any dust filtering into the oil has a tendency to lower its insulating value to a point where it is unfit for use.

The resistance-type starter in the hands of the average operator of equipment in the plant gave fairly positive assurance against jerky starting of elevators and conveyors. It is not always possible to train employees to judge the exact moment when in manual compensator operation, the

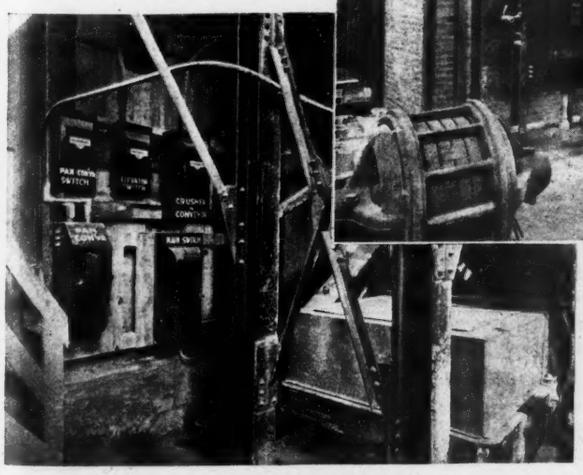
* * * * * * * *

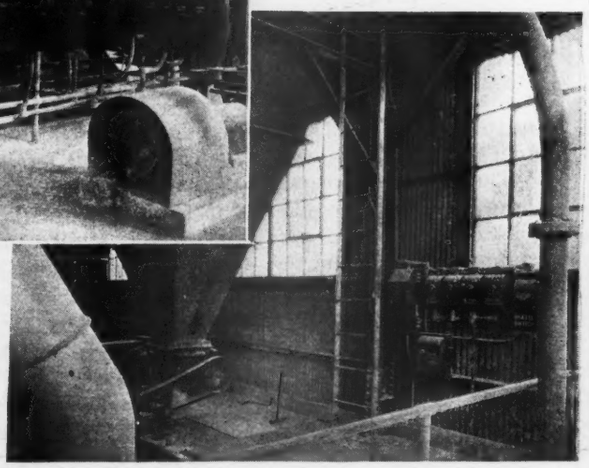
GROUPING of control equipment makes not only for convenience but for efficiency, less labor effort and expense. These starters control the motors driving the mills.

MAIN and branch switches for control of individual circuits in the raw end. The pan conveyor starter controls the dryer feed through a variable-speed mechanism..



MAIN CIRCUIT control switch with controls for ground gypsum conveyor motors, kettle dust collector fans and dust collector rapper motors.



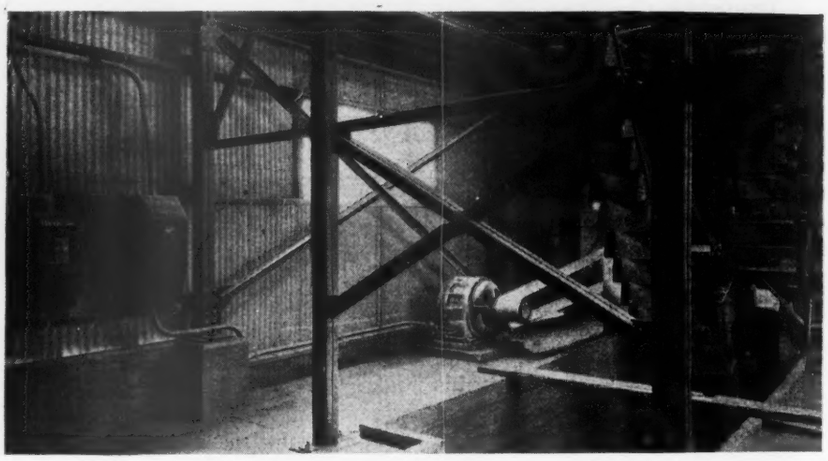


WHAT PRICE SIMPLICITY in this installation? Here is the control equipment for a crusher and a conveyor handling the plant output. Below is shown a mixer and packing machine control in a department where the calcined gypsum is combined with other ingredients in the manufacture of wall plaster.

* * * *

starting handle must be thrown from the starting to the running position, but with the resistance starter this is taken care of automatically. In the same way "inching" the equipment for the purpose of slow turn-over for oiling different parts is not only permissible but easily facilitated without damage to the contacts. This feature also permits more careful inspection of machinery by making it easy for the repair crew to move machines and conveyors slowly while making inspections. All starters mentioned heretofore were equipped with overload relays and no-voltage release devices. In conjunction with the no-voltage releases, push-button stops were installed in many convenient locations, being so interconnected that in case machines stopped from any cause, all other machines and conveying apparatus ahead would be stopped also, while machines or conveyors following in sequence would continue to operate until their contents had been discharged.

This system of interconnection proved invaluable in preventing the piling up of material at any specific point. It was also found that the resistance starters fully met the needs of the installation in starting up the equipment under full load without undue rush of current in the lines. In the reconstruction of the same company's New York plant which was destroyed by fire the writer has again specified and is installing similar starting equipment.



Industrial Engineering to Furnish Equipment Guide

EQUIPMENT is of prime importance in industry. With antiquated or obsolete equipment, production is not at its best. Without adequate equipment, that division of industry rendering "service to production" is handicapped.

During recent years much more attention has been given to bringing the production machines up-to-date, than to modernizing the "service to production" equipment.

Your industry publication, *Industrial Engineering,* is now providing the first equipment information service comparable in size and scope to the outstanding services that are being rendered in regard to production machines. Fifty per cent of the January issue of *Industrial Engineering* will be devoted to a review of equipment introduced during 1928 and described in its pages during that year.

The January issue will on that account be a reference issue, or equipment guide, of value throughout the year. It will be an issue that you will want to keep on your desk or in a handy drawer to be of first assistance in selecting the equipment necessary to enable *you* to render the best possible "service to production" in your unit of industry.

LOCATION OF PHASE COILS *IN* A.C. WAVE WINDINGS

By A. C. ROE

Renewal Parts Engineering Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

REPAIRMEN are sometimes confused regarding the location of phase coils and short-throw top-lead, or short-throw, bottom-lead, coils in the wave windings used for the rotors or stators of induction motors. This article will describe these coils, the method of marking and the reasons for using them, with data for their correct location.

Phase coils have an extra layer of insulating material applied to the ends, and are used at the beginning and ending of each pole-phase group. They are marked with red paint to distinguish them from the plain coils.

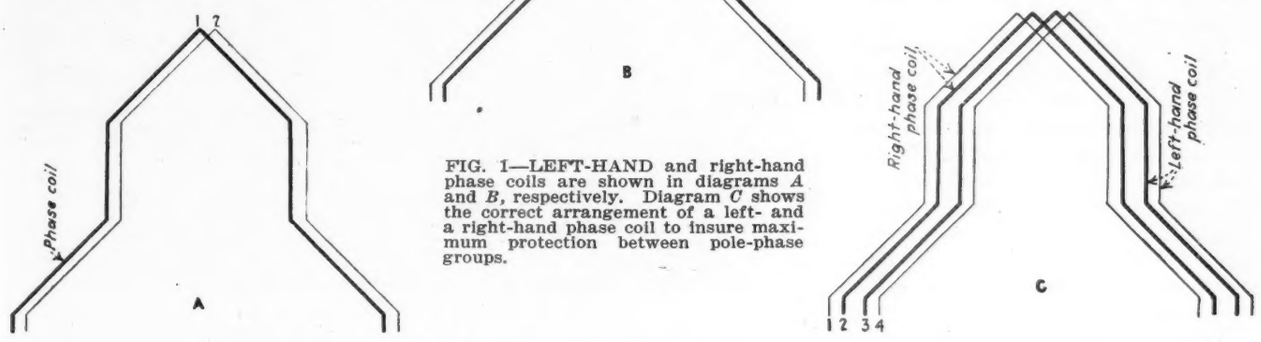


FIG. 1—LEFT-HAND and right-hand phase coils are shown in diagrams *A* and *B*, respectively. Diagram *C* shows the correct arrangement of a left- and a right-hand phase coil to insure maximum protection between pole-phase groups.

In some cases, all of the coils in a machine are reinforced on the ends, making what is termed "all phase coils"; thus their proper location is simple.

When there are two or more single coils per slot, it becomes necessary to use right-hand and left-hand phase coils. This means that, when holding the coil in the position that it would assume when in place on a rotor, and with the leads pointing towards you, if the extra insulation is on the left-hand side, it is a left-hand phase coil.

Fig. 1 *A* shows a left-hand phase coil, so termed because the single coil to the left has the ends reinforced with extra insulation, and Fig. 1 *B* shows a right-hand phase coil. In both diagrams the heavy-line coil indicates the phase coil; the coils shown are for a winding having four conductors per slot.

Fig. 1 *C* shows how a right- and a left-hand phase coil should be arranged so that the maximum protection may be obtained between adjacent pole-phase groups. Thus, single coil *2* is the end of one pole-phase group, and single coil *3* is the beginning of the next adjacent pole-phase group.

To determine the proper location of the phase coils, it is necessary to know the number of coils per group. Bear in mind that a wave winding differs from a lap winding, due to the fact that the wave winding divides each phase into two sections, and these two sections may, or may not, have the same number of coils.

For example, assume a four-pole, three-phase winding having 90 slots; then the total number of sections equals 6, and $90 \div 6 = 15$ coils per section. But, as a four-pole wave winding has a series of two coils, the number of coils per pole-phase group in one section equals $15 \div 2 = 7$, with 1 left over. Also, as each phase has 30 coils, $30 - 14 = 16$ coils for the second section and $16 \div 2 = 8$ coils per group for the second section. Thus, the grouping is odd; that is, seven and eight coils per group, and the total number of phase coils equals the number of poles times the number of phases times two, or $4 \times 3 \times 2 = 24$.

If the winding has four or more conductors per slot, the total number of phase coils must be equally divided into right-hand and left-hand coils.

The rules for locating the slots in which the phase coils are placed were given in the articles appearing in the September, October, November, and December, 1924, issues of *Industrial Engineering*. It is best, however, in cases where the grouping is odd to use all phase coils, providing there is sufficient end room, as this procedure saves time and insures proper phase protection.

When the grouping is even, which can be checked by dividing the total number of slots by the number of pole-phase groups, all that need be remembered is that the beginning and ending of each pole-phase group must have a phase coil. However, a wave winding for rotors must have the leads brought out at a predetermined position as the spider and hub are drilled and tapped for cleats and supports. Also, the leads to the col-

lector rings are in a fixed position; thus, care must be taken to start with a lead coil, which is also a phase coil. so that the first and last coils in are phase coils.

Fig. 2 *A* shows a working diagram of the winding mentioned above. and Fig. 2 *B* shows the arrangement and method of numbering the conductors in each slot. The table in Fig. 2 gives the slot and conductor numbers for the proper location of the phase coils. Note that the table refers to the bottom half of the coil, as it is placed in the slot first; this method of reference makes it unnecessary to count back the coil pitch, as would be required if the top half of the coils were given in the table.

In Fig. 2 *A,* note that the A-phase lead is the left-hand single coil, or conductor *2,* in the bottom of slot *1,* and that this is a left-hand phase coil. The slot and conductor numbers listed in the table locate the beginning and ending of each pole-phase group. Thus, in slot *2,* conductor *4* is indicated as a right-hand phase coil. In other words, the table indicates the proper placement of the phase insulation.

Fig. 3 shows a six-pole, 72-slot winding, four conductors per slot, with the phase coils marked and indicated by heavy lines. Table I gives the slot location of the phase coils, indicates whether they are right or left hand, and also locates the leads, star and reversing jumper connections. The winding shown in Fig. 3 has an even grouping of $72 \div 18 = 4$ coils per group.

Wave windings have six places where a short lead throw is used. This is always at the end of the series of $P \div 2$ coils where P equals number of poles in the winding. The short throws are always between the leads that start and finish a section. These places are indicated in Fig. 3 by the letter *J* and in Fig. 2 by *X*.

When connecting up a wave winding, the top and bottom leads of the coils at the short-throw positions must be bent to suit. However, on machines where the distance between the center lines of adjacent slots is an appreciable amount and the cross-section of the conductor is large, it is extremely difficult to shape the coil leads to the required short throw.

To save time in winding and connecting up such machines, special lead coils are made up. These are called short-throw. (ST) top-lead and short-throw. bottom-lead coils, and have the leads formed short to fit correctly at the short-throw position.

This procedure adds further complications, as a study of Figs. 2 and 3 will indicate that the coils at the beginning and ending of each section must have short-throw leads and that these are also phase coils. Thus, when short-throw-lead coils are supplied, a certain number must be phase coils, so that with four or more conductors per slot we will have right- and left-hand phase coils with short top and short bottom leads.

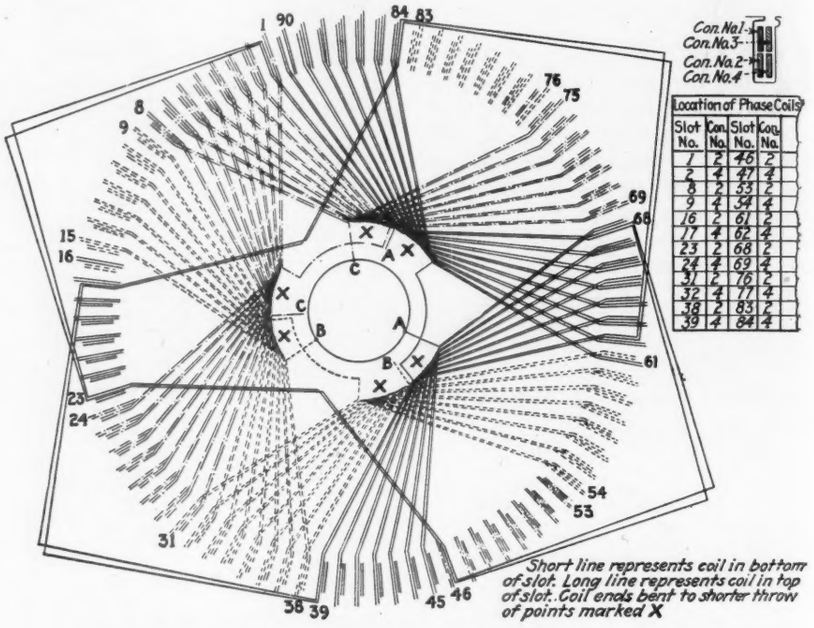

Con.No.1
Con.No.3
Con.No.2
Con.No.4
Location of Phase Coils
Slot No. | Con. No. | Slot No. | Con. No.
1 2 46 2
2 4 47 4
8 2 53 2
9 4 54 4
15 2 61 2
16 2 62 4
23 2 68 2
24 4 69 4
31 2 76 2
32 4 77 4
38 2 83 2
39 4 84 4
Short line represents coil in bottom of slot. Long line represents coil in top of slot. Coil ends bent to shorter throw of points marked X

FIG. 2—WORKING DIAGRAM, *A*, of a three-phase, four-pole, 90-slot, retrogressive winding with series-star connection. In this winding there are 24 phase coils—12 right-hand and 12 left-hand coils. The location of the phase coils is given in the table. The coil grouping is uneven, as there are seven coils per group in the first section and eight coils per group in the other. Diagram *B* shows how the conductors are arranged and numbered.

* * * *

However, we can establish a rule, based on the fact that there are six short-throw positions and at least twelve short-throw, bottom-lead and twelve short-throw, top-lead coils, as follows:

(1) The total number of phase coils equals the number of poles times the number of phases times two.

(2) With more than one strap per cell, insulated separately, half of the total number of phase coils will be right-hand and the other half left-hand coils.

(3) When short-top- and short-bottom-throw lead coils are used, the phase coils will be divided as follows:

Table I—Location of Phase Coils for Winding in Fig. 3

WINDING CONTAINS 36 PHASE COILS: 18 RIGHT- AND 18 LEFT-HAND COILS

Bottom of Slot	Left-Hand	Right-Hand	Bottom of Slot	Left-Hand	Right-Hand
1	√		37	√	
70		√	34		√
69	√		33	√	
66		√	30		√
65	√		29	√	
62		√	26		√
61	√		25	√	
58		√	22		√
57	√		21	√	
54		√	18		√
53	√		17	√	
50		√	14		√
49	√		13	√	
46		√	10		√
45	√		9	√	
42		√	6		√
41	√		5	√	
38		√	2		√

Slots are numbered counter clock-wise
Odd-numbered slots contain left-hand coils
Even-numbered slots contain right-hand coils
Leads go out from the bottom of slots 1, 17 and 57
Star connections are made from the bottom of slots 5, 45 and 61
Reversing jumpers go from:
Top of slot 2 to top of slot 62
Top of slot 58 to top of slot 46
Top of slot 42 to top of slot 30

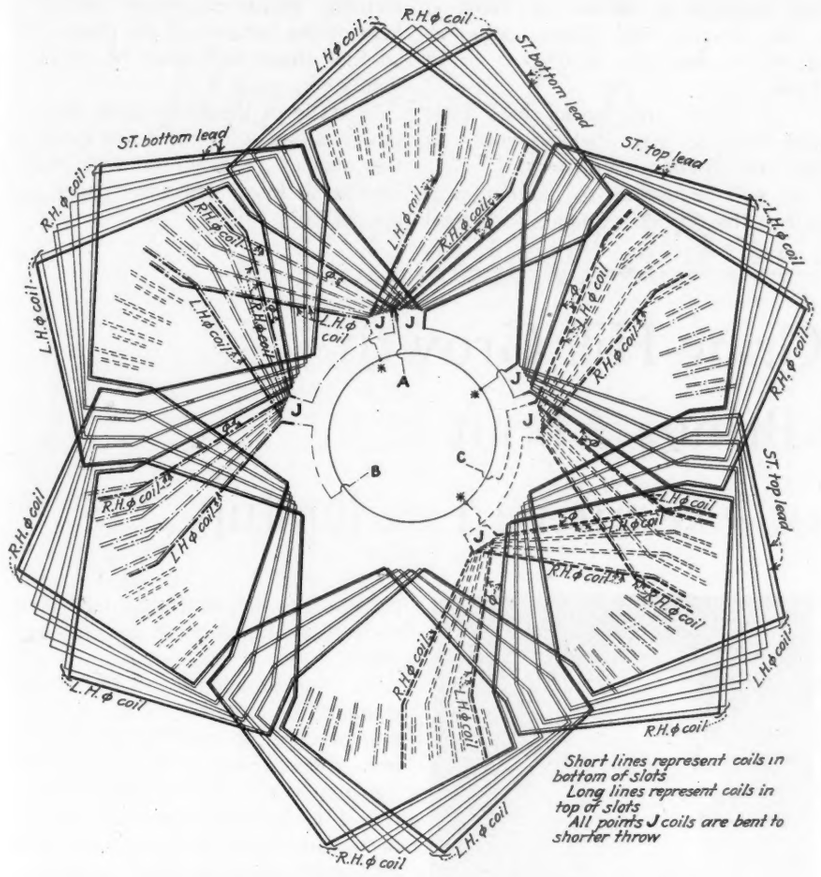


FIG. 3—THE HEAVY LINES show the phase coils in a three-phase, six-pole, 72-slot winding having four conductors per slot. In this winding there are 36 phase coils—18 right and 18 left hand. The location of the phase coils, leads, and star and reversing jumper connections are shown in Table I.

* * * *

(a) With one strap per slot, the total number of short-throw, top-lead coils per set equals six times the number of slots per pole per phase.

The total number of short-throw, bottom-lead coils per set also equals six times the number of slots per pole per phase.

In each of the above cases, the number of phase coils will be twelve top-lead and twelve bottom-lead coils.

(b) To find the number of full-throw phase coils, find the total number of phase coils required for the complete machine and from this total subtract twelve top-lead and twelve bottom-lead coils, or 24; the remainder will be the total number of full-throw phase coils. This relation is worked out in Table II for three-phase machines having from four to 24 poles.

(c) When there is more than one strap per coil, there will have to be:

Six right-hand, short-throw, bottom-lead phase coils.

Six left-hand, short-throw, bottom-lead phase coils.

Six right-hand, short-throw, top-lead phase coils.

Six left-hand, short-throw, top-lead phase coils.

The remainder of the phase coils will be full-throw, half being right-hand and the other half left-hand coils.

The above is for machines that have the beginning and ending of each pole-phase group insulated as phase coils.

The number of plain, short-throw lead coils will be equal to one less than the number of coils per group times twelve: twelve subtracted from this product equals the number of plain, short-lead coils. Half of this number will be short-throw, top-lead, and the other half short-throw, bottom-lead coils.

Consider Fig. 3; in this winding there are four coils per group. Then, $12 \times 3 = 36$, and $36 - 12 = 24$ plain, short-throw coils made up of twelve short-throw, bottom-lead and twelve short-throw, top-lead coils Therefore, the phase coils and short-throw coils for the winding in Fig. 3 will be as follows:

Thirty-six phase coils and thirty-six short-throw-lead coils.

Six left-hand, short-throw, top-lead phase coils.

Six right-hand, short-throw, top-lead phase coils.

Six left-hand, short-throw, bottom-lead phase coils.

Six right-hand, short-throw, bottom-lead phase coils.

Six left-hand, standard-throw phase coils.

Six right-hand, standard-throw phase coils.

Twelve short-throw, top-lead plain coils.

Twelve short-throw, bottom-lead plain coils.

It is obvious that care must be taken when recording rewinding data preparatory to stripping a wave winding. The following procedure should be observed when taking rewinding data:

(1) Record the number of slots in the stator.

(2) Locate any one lead, mark the slot it comes from No. 1, and record whether the leads are from the top or the bottom of the slot.

(3) Record the type of coil; that is, whether it is a right-hand or left-hand coil.

(4) Locate the other leads and

Table II—Number and Kind of Phase Coils in Three-Phase Machines Having 4 to 24 Poles

Number of Poles	Total Number Phase Coils	Top Short-Throw Phase Coils	Bottom Short-Throw Phase Coils	Full-Throw Phase Coils
4	24	12	12	0
6	36	12	12	12
8	48	12	12	24
10	60	12	12	36
12	72	12	12	48
14	84	12	12	60
16	96	12	12	72
18	108	12	12	84
20	120	12	12	96
22	132	12	12	108
24	144	12	12	120

star connections, give a slot number and note whether they come from the top or the bottom; or use a conductor number, giving the conductors in the top of the slot odd numbers, as 1, 3, 5, etc., and those in the bottom of the slot the even numbers, as 2, 4, 6, etc. See Fig. 3.

(5) Locate and record the reversing jumpers as shown in Table I.

(6) Locate the phase coils as shown in the table in Fig. 2, or in Table I.

(7) Check for special lead coils and indicate them, where used, by slot and conductor numbers.

It will be useless to number each coil in the proper sequence with steel stencils, unless a proper record is kept of the location of the phase coils so that these coils may be properly insulated.

A study of the above data, figures, tables, along with the rules given in the articles referred to will enable anyone to locate correctly phase and special lead coils.

McGraw-Hill Growth Brings About Division of Executive Leadership

RECENT growth and expansion of the McGraw-Hill Publishing Company have led to action by the Board of Directors, it was announced Nov. 1, 1928, separating the offices of Chairman of the Board and President of the company, both of which have hitherto been held by James H. McGraw. Under the new plan of organization Mr. McGraw will continue as Chairman of the Board. Malcolm Muir, formerly Vice-President, has been elected President of the company and Chairman of its Executive Committee. James H. McGraw, Jr., Vice-President and Treasurer, has been elected Vice-Chairman of the Board, and Chairman of the company's newly-created Publishing Committee.

Through merger and purchase in recent months the McGraw-Hill Publishing Company now comprises nine subsidiary and associated companies publishing business and industrial magazines, engineering books, catalogs and directories. Twenty-four magazines serving ten fundamental industries and covering business broadly are published at such widely distant points as New York City, Chicago, San Francisco and London. The direct effect of this co-ordination of related publishing interests will be to enhance publishing facilities for the group as a whole beyond those which any single paper or lesser group might enjoy. At the same time, the official announcement of the Board of Directors points out, these developments have greatly multiplied executive responsibilities and have necessitated a readjustment of the administrative duties of the company's principal officers.

MALCOLM MUIR

Mr. Muir will be the chief executive of the McGraw-Hill Publishing Company, with full authority and responsibility for the operation of the company's business. He has been with the organization for the past 23 years and has been identified with many phases of its activities. During the past ten years particularly he has taken an active part in each step of the company's growth. He has been a leader in the work of the Associated Business Papers, serving as President in 1925-1926, and has been an important factor in raising the publishing standards of the business papers.

Mr. McGraw will continue no less actively in the work but will be enabled to devote himself more freely to the inspiration and guidance of the editorial leadership of these many publications to which he has given such absorbing interest for so many years.

In the broadened scope of the company's activities with its correspondingly greater responsibilities and opportunities for service, this division of the top burden of executive direction brings new strength to the organization and promise of an increased capacity for service to industry.

Mr. Muir's proven sympathy and enthusiasm for the principles for which McGraw-Hill papers have stood so consistently for so long is a complete assurance of their continuance as the basic policy of this house.

Committee Appointed on Heavy-Duty Anti-Friction Bearings

George T. Snyder, chairman of the Iron and Steel Division of the American Society of Mechanical Engineers, has announced the appointment of a Division Sub-Committee on heavy-duty, anti-friction bearings. The personnel of this committee is as follows: Lane Johnson, chief engineer, United Engineering & Foundry Company, Pittsburgh, Pa.; C. H. Hunt, chief engineer, Weirton Steel Company, Weirton, W. Va.; R. C. Stiefel, engineer, Ellwood City, Pa.; H. E. Brunner, chief engineer, SKF Industries, New York, N. Y.; G. C. Farkell, superintendent, Rolling Mills, National Tube Company, Lorain, Ohio; W. Messinger, Hydraulic Tool Works, D Street, Philadelphia, Pa.; Sidney G. Koon, secretary, associate editor, *Iron Age*, New York City.

Brighten-Up the Dark Days

C. STANLEY TAYLOR

Compares daylight and artificial lighting effects in the plant of James Lees & Sons Company Bridgeport, Conn.

THESE are the days when the short daylight period emphasizes the need for adequate artificial lighting. It has been proved by actual test that increasing the lighting intensity in a factory from an average of around two foot candles to over ten foot candles has increased production 12 per cent or better. This indicates an important opportunity for production economies to the plant manager and his service staff.

Among the things to do, that will offset the lack of adequate natural lighting in the morning, and particularly in the afternoon hours, is to go over the entire layout with a view to determining whether or not the present circuits are adequate to carry an additional load so that the present outlets may be supplied with lights of higher candle power. If not, consider the cost and advantage of installing new circuits so arranged as to supplement or replace the present outlets with a view to bringing up the average intensity of lighting throughout the plant to accord with modern practice.

Another point is to check over the reflectors that are used. Many advances have been made in design of reflectors, both of the open and inclosed types, and their proper use has often increased the lighting without increasing the electric load by an amount sufficient to justify the expense of new equipment the first year.

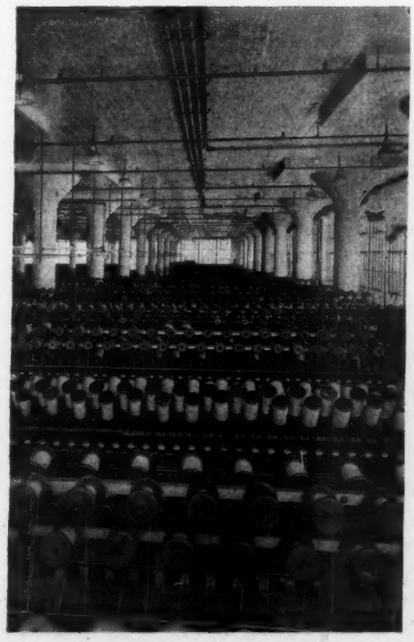
Whether or not new fixtures are determined upon as being necessary, the effort immediately to clean and polish all of the reflectors in place, also clean the globes and replace those which have begun to discolor, will be worth all it costs. It should be remembered that dust and slight discoloration on the globes or dirty reflectors will drop the lighting efficiency by 40 per cent within a short period after new equipment is in place, making this one of the most important maintenance problems in the plant where lighting is a primary requisite.

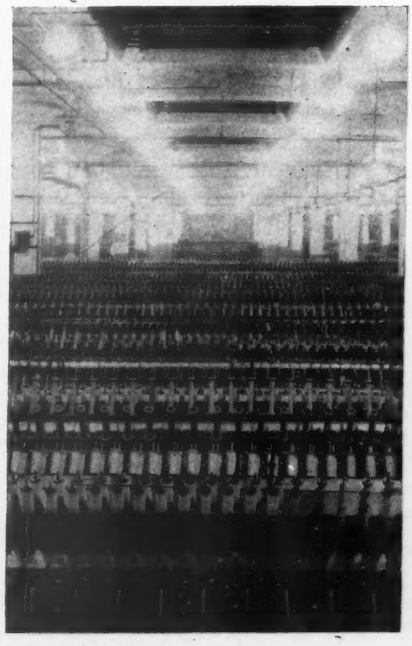
Another aid to better lighting is the repainting or cleaning of walls and ceilings. If repainting is necessary, the use of high-grade paints of maximum reflecting and diffusing power is recommended with a definite preference for the semi-gloss or eggshell finish.

Artificial lighting is not the only thing to keep in mind, for every extra minute that natural lighting can be utilized saves on the power bill. Hence, window cleaning should be on the maintenance program at this time of the year, especially if a regular schedule of adequate frequency of window cleaning is not followed.

One more thing to be done is to consider the use of special light diffusing and reflecting glass in the upper parts of windows, which are depended upon as the source of light for deep rooms. There are a number of prismatic glasses, which have the property of throwing the light rays in a horizontal direction, and which have a marked capacity for improving the lighting in the areas remote from the window. Although such glass is of higher cost than the ordinary factory ribbed glass or rough wire glass, its use may be worth while in a few windows where this extra lighting is desired.

* * * *





DARK DAYS have no influence on production in this plant. The daylight view at the left is indicative of the means used to eliminate shadows. At the right, a view at night. Holophane No. 621 units are shown mounted 12 ft. above the working plane with four units allotted to each 21 x 24-ft. bay.

Plant Engineer's

Conducted by F. M. GIBSON, *Consulting Editor.*
Plant Engineer at American Sugar Refining Company

IT WOULD be difficult to mention any other branch of engineering that calls for so broad a scope as that of industrial engineering. Every week and sometimes every day a new problem arises involving a different branch of engineering. The following will illustrate how the problems come.

The steam system becomes unbalanced and a study must be made as to how it can be stabilized. Greater

use of exhaust steam must be found or power must be generated with less production of exhaust steam or production in various departments must be scheduled so as to avoid peak loads.

Labor is very high in one department and some way must be devised to handle material mechanically, to reduce that cost.

Some one suggests that waste material be processed in a different manner so that it will be more saleable and the best method for so doing with estimated cost must be reported to the management on the following Tuesday.

One department is experiencing corrosion of metals and some non-corroding metal with all the resistance of a steel alloy must be secured at a price of not over 15c. a lb.

It is suddenly discovered that the offices are poorly heated, ventilated and lighted and new systems must be worked out.

A new filtering agent is developed but its use involves major alterations in screens, washing, recovery and mixing, all of which must be developed in design, and costs estimated, to determine the possibility of using the new agent.

There is a demand for an automatic machine, never before developed, to perform a certain operation now done manually.

A proposal is made to run another railroad track in the yards and a layout must be made.

A request is made for a study to determine how fire insurance rates may be reduced.

A new product is to be produced which will require refrigeration.

Additional equipment is installed, causing an overloading of electric transmission lines, and a study must be made to determine how far it is necessary to go in redesigning the system.

Columns in a certain building show settlement and the cause must be determined and corrected.

Lubrication costs rise and must be investigated.

It becomes necessary to interlock electric controls of certain groups of equipment to safe-guard against accident or spoilage of goods.

The legislature passes new sanitary or labor laws and a survey must be made to determine what is necessary to comply with them. And so we might go on for several pages.

It is expected of the industrial engineer that he be able to solve these problems quickly and to give a reasonably accurate estimate of the costs. To do so he must have a knowledge of advanced engineering in all branches or know where to get it. He must read widely in technical publications and also secure proceedings of engineering societies. In technical readings he has publications such as *Industrial Engineering* to

cover the field for him, but the same does not hold true in engineering societies.

In the A.S.M.E. the members are divided into 16 professional divisions and it is considered by the officers of the society that a number would be interested in probably 3 divisions. Most industrial engineers are interested in 6 divisions and in certain industries such as wood and textile it means 7 divisions. Even these divisions do not cover his field in such branches as electrical, civil, heating and ventilating, refrigeration, accident and fire prevention and maybe some other branches. Then, in addition to all of these, he wants information regarding the ability of contractors and consulting engineers to perform the peculiar tasks that he has in hand.

It is not possible for one man to thoroughly cover such a field and, as a rule, industrial firms are not overly liberal in supporting a large staff. There is a limit to the number of periodicals that can be read and to the number of societies that can be joined. Therefore the engineer must depend heavily upon a wide acquaintance in his profession. Among these he will usually find one who has had experience in the particular problem in which he needs assistance.

The most valuable help is discussion of timely subjects. This can be obtained in a broad way only by regular meetings of a group of industrial engineers. That has been my experience and I know nothing better to build up information than such an organization. It need not be a large organization: a half dozen engineers, meeting every month, is sufficient for a beginning. An organization is forming in New York and there is talk of one in Philadelphia. Why don't you start one?

* * * *

It is a rare pleasure for an industrial engineer to be engaged in the layout of a complete new system of transmission lines for a plant. Most of his time devoted to transmission of electricity, steam, water, air or any other commodity is limited to increases or alterations for a single installation. Usually the problem is confined to securing sufficient supply from the nearest point possible and is not extended to the consideration

's Forum

of the effect of new transmission lines upon existing lines through which the additional lines must travel. In the course of a few years, what was once a good system becomes a ramification of overloaded and underloaded lines resembling somewhat the roots of witch grass.

Often times the installation of additional equipment increases the amount of transmission to the extent that the overloading of existing lines is sufficient to make a revision of the general system profitable. Some engineers make the mistake of including the cost of revision of the transmission system in the cost of installation of the new equipment. This increase of installation cost is sometimes ruinous to the estimated savings to be obtained by the new equipment and fosters opposition from those who are more interested in the benefits of the new equipment than they are in transmission losses. More often, the lack of time or funds postpones the revision of lines to a later date which somehow or other never arrives.

Most industrial engineers are so occupied that they have little opportunity to review their transmission systems and estimate the savings that could be effected by revision. Regardless of the reason for the condition, many of the older plants would find a handsome profit in redesigning their transmission systems.

* * * *

A great deal of consideration is being given in technical papers to the balancing of steam systems particularly by the use of higher steam pressures. The subject matter in these discussions refers almost entirely to the method of generating steam and power. To my mind this is a one sided discussion and is the secondary step in arriving at the correct solution of the problem. The error lies in taking present demands for heat and power as a basis for determining the type of equipment for generating power and the boiler steam pressure in the future.

Present demands are usually not reduced to an economical amount. In some plants heat is used inefficiently for the reason that if it is not used,

exhaust steam will be blown into the atmosphere. Other plants could use more electric drives profitably but refrain from doing so because additional power would create more exhaust steam which would overload that system.

I have also found that in plants not suffering from unbalanced steam systems, heat and power is being wasted and in some cases a sufficient amount of either is not being used.

Vassar College revised its heating system and saved 20 per cent in fuel used. In another case, a power plant was built on Long Island and after its installation a survey of the use of power resulted in a reduction of 30 per cent in its use. These are the things that should be done before the demand for heat and power is established as a basis for determining generator equipment.

* * * *

There are many ways of rebuking mechanics for poor workmanship. The most effective one that I ever heard was used by Dan Hickey. After surveying a piece of work that

was considerably out of line, he turned to the mechanic who was responsible and remarked:

"Looks as though you had made it yourself."

It is always better to use standardized equipment, but in industrial work it is not always possible. Equipment is not placed on the market unless it has a sufficiently large field of application to warrant its manufacture in reasonably large quantities. Hence it is unreasonable to expect that there will be standard appliances to fit the peculiar problems of the individual industry or plant.

The industrial engineer is usually justified in developing home made equipment regardless of those who have been criticizing him. For instance, materials handling has been intensively developed in recent years, but there are many needed appliances that are not on the market. Particularly is this true in the handling of slings of boxes or bags.

Many plants receive their raw material in heavy containers and it is

not practicable to unload them, in individual units from boats, cars, and in some cases from trucks. It is necessary to unload them in slings and men are needed at each transfer point to unhook and rehook the slings. An appliance for automatically transferring the slings would save a great deal of labor, and if an engineer wants one he will have to develop it. In fact, one engineer has already done so.

However, it is likely that in the near future there will be but little use for such an appliance as it is better engineering to break up the sling load as soon as possible and deliver the containers individually on a conveyor. In some cases very ingenious machines have been developed for separating the sling loads into a continuous stream of individual units delivered to a conveyor. The greatest need in this system is an automatic scale that will weigh rapidly and with sufficient accuracy, particularly when weights are to be obtained for import tax.

QUESTIONS *Asked and Answered By Readers*

HERE IS A PLACE *where you can get some inside information when you get stuck. The only restriction is that you do a good turn to the other fellow when he asks a question that you can answer from your experience*

Calculating Size of Transformers Required

The power requirements of our plant aggregate 1,865 hp., and are supplied by steam engines. We are going to change to electric drive, using 440-volt induction motors ranging from 10-hp. to 100-hp. rating. Power will be purchased at 2,300 volts, three-phase, 60 cycles, and stepped down to 440 volts by a bank of three, single-phase transformers connected delta-delta. Will readers please tell me (1) how to calculate the size of transformers required to deliver 1,865 hp. (actual load), allowing for usual losses and slight overloads at times. (2) What current in amperes will be carried by each line in the primary and secondary sides of the transformers at full load? (3) Will a choke coil be necessary in the primary side? If so, what size should it be? G.F.A.
Marseilles, Ill.

* * * *

Method of Calculating Torque

I understand that the torque of a motor is expressed as the pounds pressure exerted at a distance of 1 ft. from the center of the armature. Is this correct? Will someone also please tell me how to calculate the torque exerted by the shaft of a drum that is driven by a 30-hp. motor (which has a torque of 200 lb.-ft. at 800 r.p.m.) through a twenty-tooth motor pinion meshing with a 200-tooth gear? L.A.J.
McKeesport, Pa.

* * * *

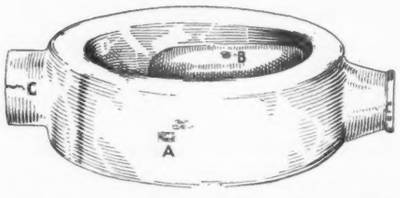
How Can Better Painting Results Be Obtained?

Our production program calls for constant operation; in other words, we run both day and night up to Saturday noon. The plant is closed down from Saturday noon to Monday morning. Manufacturing processes are done in the presence of a great amount of moisture, heat and more or less condensation during the winter months. As a consequence it is almost impossible to have dry surfaces to paint over them. What can we do to insure better results than we are getting at the present time? We realize that conditions are bad, but believe that there must be some way of minimizing their effects. R. E. S.
Woonsocket, R. I.

* * * *

This Casting Cracks After Being Arc-Welded, Why?

I am troubled with castings cracking after they have been electrically welded and want to know if there is any remedy for this other than pre-heating? The



CAST IRON PIPE having slag holes at *A*, blow holes at *B*, and cracks at *C* that showed cracking at welds after the welding was completed.

cast iron pipe shown in the accompanying illustration weighs 200 lb., is from ¼ to ⅜ in. thick and has slag holes at *A*, blow holes at *B*, and cracks at *C* in the walls. All welding was done in the usual manner to eliminate the above defects using ⅛-in. C.I. welding rods but after the welding was done cracks appeared at the welds. Other welders can probably help me with this problem, which is so costly and annoying. C.A.
Huntington, Ind.

* * * *

What Is the Theory of This Relay?

In a G. E. type T A, K-6 voltage regulator there is a relay magnet whose winding consists of two separate coils with three main taps *A, B* and *C*. What I would like to know is, what is the object of having half of this magnet winding in the circuit continually, and the other half in the circuit only when the main contacts are closed?
Weiston, W. Va. A. H.

Correct Thinning Solution for Stock Paints

We have our own paint shop and carry a fairly large supply of maintenance paints in stock. Some of these are oil paints, and some are enamels. After having been opened, some of the contents used, and then closed again for later use, we find considerable thinning necessary when desired again to use. We would like to know the correct thinning materials to use. Is there any general guide that can safely be used in solving this problem? Your suggestions will be very much appreciated. G. E. F.
Yonkers, N. Y.

* * * *

Why Does This Hemp-Cord Copper Cable Break?

We experience a peculiar trouble with the cable of one of our three-phase, single-circuit, 60-cycle 42,000-volt transmission lines located in the tropical region where for four months of the year high winds carry salt and sand. This line consists of a single run of steel towers 600 ft. apart on which the 2/0 B&S gage, 6-strand hemp-cored copper cables are suspended in triangle position. The trouble is that the cable breaks frequently at about the middle of the span. Two or three wires in a strand usually part before the final break, which condition can easily be noted when examining the cable. Black spots show at the point of fracture and the hemp cord shows signs of being rotten and bleached out, although installation was made in 1914. In different places along the cable surface a black putty substance has been creeping out between the wires where it concentrates and forms small eruptions and gives the cable an oily appearance. This problem must be solved soon, so can someone advance a reason for the frequent breaking which occurs both in and out of the high-wind period and tell us what we can do to prevent the recurrence? I shall be very grateful for the suggestions of other readers who may have experienced similar troubles.
Orizaba, Mexico. B. C.

ANSWERS *Received to Questions Asked*

Can Formation of Static on Belts Be Prevented?

I should like to know if leather belts can be treated to prevent the formation of static electricity. Grounding by means of a comb or collector will drain off the charge, but I should like to prevent its formation, if possible. When belts are operating in the presence of explosive dust or fumes, I feel that there is always a chance of the discharge between the belt and a comb causing an explosion. If anyone has solved this problem, I shall be grateful for the details.
Chicago, Ill. L.C.W.

ANSWERING L. C. W.'s question, I have found that trouble with static is greatest where the belts slip, and where the joints in the belts are made by metal fasteners which are badly made. It is desirable that there should be but one joint in the belt if it is made by a metal fastener. The body work of the machine should be grounded, as well as the shafting. Reducing the static in the belt by means of a metal comb is effective, but in cases and where explosive dust is present, it is best to use two or three combs equally spaced along the belt in order to reduce the amount of sparking as the static leaves the belt. When the belt is bone dry the trouble is more pronounced than when it is moist, which makes it desirable to use a dressing on the belt to keep it moist.
Brentford, England. W. E. WARNER.

THE THING which causes the collection of static electricity on belts, answering the question raised by L.C.W., is the friction between the belt and the air with which the belt comes in contact. The belt must be moving at or above a certain critical speed for the static to collect. This should suggest at once a change in the system of pulleys and belts so that the fastest belt in the place where an explosion might occur, would operate at a speed below the critical static speed. Of recent years many applications have been for the economical applications of speed-reducers consisting of worm and worm-wheels running in oil; if such a speed-reducer may be employed, then of course, no danger from static will exist.

L.C.W. does not say that his belts are motor driven, but if they are, d.c. motors should not be employed in a place where gas or dust may be exploded by the sparking at the brushes. There is much more danger of sparks from motors causing an explosion than from belts driven by motors. A good arrangement would be to have the driven equipment separated from the driving equipment by a brick wall to isolate the explosive mixture, then pass the drive shaft through an air tight bushing in the wall. If the high-speed belt drive must be kept, it is believed that it should be possible to ground the belt with a "comb" for removing the static as it forms and thus preventing its collection up to the capacity of the belt when it may discharge in a hot spark to some nearby object. The protection offered by the grounded comb arrangement is the same as that provided by a lightning rod on a farm house. With the belt; the comb of metal with very sharp points should be so close to the belt that a discharge takes place continually at a relatively low potential, this will prevent the collection of any great quantity of electricity and then prevent the formation of a hot spark which would ignite gas or dust. D. W. BLAKESLEE.
Electrical Engineer,
Pittsburgh, Pa.

Will New Brush-Holders Keep These Machines From Sparking?

We have four old Western Electric, 400-kw., 110-r.p.m., 250-volt generators using radial box-type brush-holders. These machines were originally designed for 125-volt operation, but five years ago were rewound for 250 volts, and the thickness of the brushes cut in half. We have tried five or six different grades of brushes, but have not found one that is entirely satisfactory, as they all spark, cut the commutator or are noisy. The brushes used measure ⅜ in. x 2 in. x 9 in. long. The commutators are undercut and slightly out of true, and I am wondering whether reaction-type brush-holders will clear up this trouble, but do not want to go to the expense of installing them unless it is necessary. I wish that readers would give me the benefit of their experience in solving problems of this sort.
Bloomfield, N. J. H.F.K.

REPLYING to H.K.F., the information is not complete enough to give a positive diagnosis. There are many causes which might contribute to the troubles mentioned, but we can go into only those indicated by the data.

Quite likely the brushes are too thin to give time for current reversal. Assuming that the turns were doubled in doubling the voltage, the original number of ampere turns must be reversed, but in half the time. When rewinding a machine under such conditions it is quite common practice to reduce the brush thickness, but not by 50 per cent. A ½-in. brush is exceptionally thin for a 400-kw., 250-volt generator. The reported brush length of 9 in. may be an error, but if it is correct the weight would give it such great inertia that it could not follow the commutator surface without excessive pressure.

A brush, and the parts of the holder which follow it, should be as light as practicable, to make good contact possible with reasonable pressure. I should not consider using a brush more than 2 in. long. It is a mistaken notion that the life of a brush is in proportion to its length. I have in mind a case where new brush-reaction holders with 1½-in. brushes were installed on a motor that had been wearing 4-in. brushes down more than ½ in. a week. Five years later this motor was commutating perfectly, and the spare set of brushes was still on the shelf. Although this is an extreme case, it indicates the falsity of attempting to get long brush life through extreme length of brush instead of by proper commutation. Of course, short brush life is only a small part of the cost of poor commutation; heating, worn commutators, and constant attention, cost many times the price of the brushes. EDWARD D. CARTER.
Engineer,
The Bayliss Company,
Bloomfield, N. J.

INASMUCH as H. F. K. has tried out a number of different kinds of brushes without success, and assuming that the machines are not overloaded, there is a possibility that the trouble is of mechanical rather than electrical origin.

For example, if the machines are not resting on a very secure foundation, vibration may be causing the trouble. I had one experience where severe sparking of a gear-driven machine was caused by running the gears at a peripheral speed of more than 1,400 f.p.m. Also I recently heard of a case where sparking and cutting of the commutator was cured by keeping the windows closed on the windward side of the power house. The soil in that locality was a light gritty sand and enough was carried into the generator room to cause all the trouble.

If H. F. K.'s machines are belt driven a poor belt joint may cause the trouble. He mentions that these are old machines and if the bearings have worn down considerably this condition will result in unequal air gaps which in turn will cause the brushes on some studs to spark, and not on others.
Scotia, N. Y. R. F. EMERSON.

IN REPLY to H. F. K., the fact that these machines were rewound from 125 to 250 volts would increase the voltage between segments, and this is liable to cause sparking.

The brush-holders must be rather extraordinary to take a brush 9 in. long and if they are old style may not be set at an angle sharp enough to prevent chattering. If they are set at an angle the commutator should run *against* the brush, so that it can lift in case the commutator has high spots. Reaction-type brush-holders are excellent in this respect.

The commutators are admitted to be "slightly out of true" which is sufficient in itself to cause sparking. They should be trued up with a commutator turning device.

I know of a 25,000-kva. rotary converter that has been sparking for years. The designers have done all sorts of things to it, but it still sparks with apparently no ill effects, and carries its load admirably, better in fact, than some others that do not spark. So poor commutation may not necessarily do harm.
EDWARD A. GIBBS.
Boston, Mass.

ANSWERS *Received to Questions Asked*

How Would You Start the Motor in This Case?

In our plant we have hand starting compensators on four similar 60-cycle, 600-volt, 150-hp. motor drives. So far, we have not had any trouble, neither do we anticipate any, but because we do not carry spare compensators I would like to have some reader tell me how one of these drives could be started in case the transformer inside a compensator should break down? Other readers probably have had experience along this line which might be of value to the rest of us. B. P.
New Bedford, Mass.

IN REPLY to B.P., I would suggest that if a starter burns out that he extend the six terminals comprising the starting element of an adjacent starter to the corresponding terminals of the defective starter, after removing the auto-transformer. In this way he can start the motor in the usual manner, using the low voltage from the good starter. The only precaution that need be observed is not to start both units at the same time.

However, I would install a six-pole, single-throw, lockable-type switch. This switch should be opened as soon as possible after the starter is in the running position and locked in the off position.

The questioner does not state the distance between motors and starters, but if the cost of the above installation is anywhere near the cost of a new transformer the most logical and satisfactory procedure would be to purchase a spare. JAMES A. COOKE.
Woodside, N. Y.

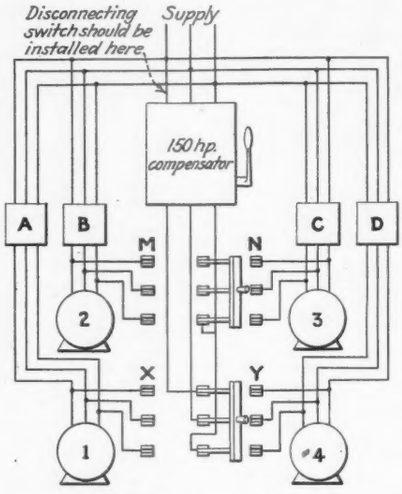
THE question asked by B. P. brings to mind a similar problem, involving the starting of two large induction motors by one compensator, that was solved several years ago. He may be able to modify the arrangement described below to suit his conditions, if he feels justified in making the necessary changes.

With the arrangement shown in the diagram, B. P. can use one compensator to start all four motors, one at a time, if they are located fairly close together. Otherwise it may be possible to split them up into groups so that two motors can be started by one compensator and the other two by a second compensator. He would then have two extra compensators as spares.

As will be seen, the compensator can be used to start any one of the motors by throwing one of the double-throw switches to the proper position, *M, N, X,* or *Y*. After the motor has come up to speed switch *A, B, C,* or *D* (depending upon which motor is being started) is then closed, throwing the motor directly across the line and the double-throw switch opened. The other motors can then be started in the same manner.

Switches *A, B, C,* and *D* should be properly fused to protect the motors. The cost of making this change would probably not be very high, as the motors are no doubt already equipped with fused safety switches; so the only expense would be for the two double-throw switches, the wiring and labor.

It is advisable to install a switch between the mains and the compensator to



WITH THIS arrangement four motors can be started one at a time from the same compensator.

permit adjustments and changes of fingers from time to time, without working on a "hot" compensator.

CHAS. A. PETERSON.
Chief Electrician,
Cold Spring Granite Company,
Cold Spring, Minn.

Trouble From Overheating of Exciter Armature

We are having trouble with sparking and heating of the armature in a 2¼-kw. exciter for a 75-hp. synchronous motor. This exciter has two poles with interpoles, and is compound-wound with automatic switch-board control. It is rated 18 amp., 110 volts, but the load seldom, if ever, rises above 15 amp. In operation the armature becomes too hot to place the hand on it, and the commutator blackens and causes excessive sparking at the brushes. Brush position has been carefully checked, and the armature winding and all connections were tested with a milli-voltmeter. The armature was replaced with a new one, but the same conditions developed again. Turning the commutator and undercutting helps temporarily, but the trouble soon returns. Will readers please tell me what to do next?
Rome, Ga. F.M.

IN his question F. M. says that he has checked the armature connections, but does not mention the field windings. It will be advisable to look these over also.

It may be that the trouble is partly due to heating of the motor shaft, if the exciter is direct-connected. If the motor bearing on the exciter end is unduly hot it should be scraped or otherwise treated to put it in good condition.

Again, if the exciter is direct-connected it may not be running true. I have known this to cause blackened commutators and arcing, especially on a taper fit. Under these circumstances the only way to true the commutator is to set up a turning rig and turn the commutator while it is in position on the motor shaft.

With the present-day principles of designing the armature may run at a temperature which seems excessively hot to the hand, but which may still be within the limits specified by the designer. The temperature should be determined by a thermometer, unless the insulation actually smokes.

Make sure that the interpoles are of the proper polarity. They should be connected for the same polarity as the main pole which they precede. Then check the wiring of both motor and exciter for grounds. There may be some leakage current that is not going through the exciter ammeter. Run the exciter for several minutes and then shut it down and see whether one main field coil is hotter than the other. If this is the case, it indicates that some of the turns of the cool one are shorted out.

Sometimes one brush will arc on a commutating-pole machine, and is usually an indication of a shorted interpole field, or reversed polarity.

GRADY H. EMERSON.
Birmingham, Ala.

IN his question, F. M. states that an armature that has been carefully checked still overheats. Assuming that the commutator is in good condition and that brush position is correct, it would seem that in some manner or other the interpoles had been reversed. This may have been done by some one reversing the armature leads at the brush-holders. I would suggest that he reverse the interpoles and see if this does not correct the trouble. Perhaps the simplest way of doing this would be to reverse the armature leads on the brush-holders, then reverse the armature connections outside the machine, so as to bring the machine back to its generation connection.

When reversing the direction of motors or reversing the armature leads for generation on interpole machines, this should always be done on the leads on the outside of the machine, thus reversing the armature and interpoles as a unit and keeping the correct relation between armature and interpoles.

When checking the polarity of the fields with a compass, in the case of a generator checking in the direction of rotation, the interpole should be of the same polarity as the next main field pole in front of it, when the current for checking is supplied from an outside source. A large lampbank or resistance bank must be used, so as to limit the amount of current flowing in the armature circuit.

Buffalo, N. Y. WALTER M. RENNICK.

ANSWERS *Received to Questions Asked*

Should Extra Men Be Hired or Work Sublet?

I should like to get the opinions and experience of readers in different parts of the country on the following question: Assume that the chief electrician of an industrial plant is capable of installing all new equipment, but has only a small force of men under him. When a big job is to be done, is it more economical or desirable to hire extra men at open shop wage rates to install the equipment, than to sublet the work to an outside electrical contractor?
Providence, R. I. W.D.B.

REFERRING to W.D.B.'s question, my experience has been that in many cases it is more satisfactory to let construction and large repair jobs to an outside contractor than to hire extra men. Some of the advantages are that the contractor's gang has its own foreman, materials, tools and so on.

To be sure, this procedure also has its disadvantages, such as a frequent lack of co-operation between the contractor's men and the plant operating force. Also, the contractor usually has to rush the work in order to make any money, and a rush job is never so well done as a job that is handled more slowly. It is only human nature for a man to leave some small detail undone, or slight it, if he is rushed. However, these disadvantages are often overbalanced by the advantages.

On the other hand, if extra men are hired it is usually difficult to work them with the regular plant gangs. The plant electrician generally has his hands full with routine work, whereas the new men are difficult to organize and will not accomplish much without direct supervision.

To my mind the best procedure in the district around Birmingham is to procure reliable electricians from some company that farms out its men on an hourly rate. Such men are familiar with all the rules of the Code, and are specialists in their line. They are usually a well-paid, satisfied class of labor and are used to working under all conditions. If more than one man is employed, one of them is made overseer or "straw" boss. These men do not need direct supervision and will do a first-class installation or repair job in a reasonable length of time. In the South there are several firms that put their men out on this basis.

I know of several companies of considerable size, comprising coal mines, machine shops, foundries, lumber mills and cement plants, that find this method of handling extra work to be very satisfactory. For example, a large pipe foundry wanted to install an electric furnace, but the electrical force was too small to handle this job and the regular work. So two men were obtained from a contractor at an hourly rate and two helpers hired on an open shop basis. The contractor's men took charge and were assisted by the plant crew whenever possible, and in a few days the furnace was completely installed.

In another case a large mining company was installing a big, automatic electric hoist, that was badly needed. When the man in charge of this work was taken ill a specialist was obtained from a contractor and put in charge. He was assisted by the mine force, and the hoist was installed in the required time.

Again, these outside men are usually good at locating trouble if any develops after the job is done and being tested. They are also especially valuable for testing equipment in cases where it is desirable to have a disinterested party do the testing.

In my estimation, this method of handling extra work when the plant force is too busy or too small to do it, is the most satisfactory. The men sent out have the backing of their company (which ordinary workmen, picked up at random, do not have) and are capable hustlers, or they would not be sent out.

GRADY H. EMERSON.
Birmingham, Ala.

Advantages of Buying Power at Primary and Secondary Rates

We are now buying power at 220 volts, 60 cycles, two-phase, four-wire, with 110-volt lighting service. Our average demand is about 150 kw., average kilowatt-nour consumption, 20,800 kw.-hr. per month. Our power bill last year amounted to $7,864.09. Our power factor is about 50 per cent, but there is no penalty for this. It has been proposed that we install two 100-kw. transformers at an estimated cost of $1,275 and buy our power at 6,600 volts two-phase. The engineer who made the proposal estimates that we can save about $950 a year. I should like to know how this can be possible. Will some reader please explain the advantages and disadvantages of buying power at the primary and at the secondary rates?
Warren, Pa. R.H.

WITH reference to R. H.'s inquiry, the information given is not sufficient to permit a comprehensive answer, but by making some assumptions, a picture can be presented which will show how economies are possible.

The maximum demand is not stated, but since an engineer has recommended two 100-kw. transformers it is safe to assume that an average was allowed on transformer capacity and the estimated figure of 175 kw. is taken as representing the maximum demand. According to the figures given, 249,600 kw.-hr. is the yearly consumption.

I do not know the rates that apply in Warren, but inasmuch as the present low-tension contract earned an average rate of 3.11 cents per kilowatt-hour on an annual consumption of 249,600 kw.-hr., the rates appear quite reasonable. Accordingly, hypothetical high-tension rates are assumed to be about $20 annually per kilowatt of maximum demand, with energy charges of 1 cent per kilowatt-hour for all electricity consumed. Allowing 2 per cent transformer losses, the energy consumption would be 254,592 kw.-hr. yearly.

Electricity costs would be 175 kw. maximum demand $\times$ $20 per kilowatt = $3,500 demand charges, plus 254,592 kw.-hr. at 1 cent per kilowatt-hour which equals $2,545.92, or a total of $6,045.92.

Eleven per cent carrying charges on $1,300 in transformer costs for interest, depreciation and insurance amount to $143 annually. This sum added to $6,045.92 gives an over-all high-tension cost of $6,188.92.

If all of the facts were known, accurate figures could be given, but the above will show the possibilities of a high-tension contract.

Disregarding the economic situation, the respective merits of high- and low-tension service depend entirely on the central station's plant layouts. On a high-tension contract, the local electric company might supply two or even three looped feeders. Or only one may be furnished and that have low-tension customers served from it; this is an undesirable condition. If the low-tension service is from a network system, the reliability of the service would probably be better than in the case of high-tension service.

The next point to consider is voltage regulation and this, too, depends solely on the central station's facilities. Either high- or low-tension supply, or both, may be served through regulators.

J. J. O. COVINGTON.
Assistant Power Engineer,
The United Electric Light & Power Company,
New York, N. Y.

IN HIS question R. H. does not give sufficient information regarding the rate situation to make it possible to compare the cost on the basis of primary and secondary rates. Naturally there would be no advantage in making the change unless there was a saving.

Fundamentally, the investment of $1,275 by the customer in transformers would relieve the utility company from the interest on this investment as well as the care and maintenance of the unit, which is usually calculated on the basis of at least 10 per cent of the investment or, in this case, $127.50 per year. It is assumed that the details of the high- and low-voltage switching equipment are taken care of. Purchasing current at 6,600 volts would relieve the consumer of an increase in the kilowatt-hour rate to take care of the iron losses in the transformers.

The questioner's average monthly load factor being less than 30 per cent would make these losses quite an item, unless the transformer bank could be switched off when not in use.

If the rate includes a demand charge as well as an energy charge there may be no advantage in purchasing on a primary basis unless the load conditions are carefully reviewed.

C. O. VON DANNENBERG.
New York, N. Y.

ANSWERS *Received to Questions Asked*

How Many Maintenance Men and Why?

Our maintenance department has been criticised for having what is considered to be too many men. For example, it requires the full time of three men to service about 200 motors, totaling 1,785 hp., and their attendant equipment. But it seems as though two men should be able to do this work. I do not want to mention the nature of our product, but I wish that readers in every industry from metal working to food products, would advise me just what their yardstick is for determining the number of maintenance men required for their plants. Is it based on the horsepower of the motors, on the number of motors and machines, or on the quantity of the product handled? S.Y.K.
Bridgeport, Conn.

REFERRING to S. Y. K.'s question, in our factories the maintenance men are expected to be familiar with all of the equipment and work in every part of them. We do not divide the equipment into sections, nor expect any man to handle only so many motors. On the contrary, our men can and do work wherever needed, and the number of men necessary is naturally determined by the amount of work and repairing.

At present we are operating 635 motors ranging from ¼- to 50-hp. rating. In our electrical department there are two repair men. These men take care of all installation work, oiling, general maintenance, and all repairs, except rewinding. Our average rewinding and coil repairing bills are about $125 annually for the entire electrical equipment. Regular inspection, oiling, and a standard overhauling schedule keeps the repair bills down, although our plant is engaged in textile work, and some of the equipment gets considerable abuse.
Ansonia, Conn. W. T. E.

I FIND that S. Y. K. does not give much information as to what he means by maintenance. If his three men who take care of 200 motors of the size indicated, have to make all repairs such as winding armatures and repairing bearings, they have their hands full.

If they do oiling, greasing, renew brushes, adjust brush-holder rigging, cleaning, exchanging armatures or rotors or field coils in d.c. machines, as well as maintain the switching equipment, feed lines, and lighting equipment, they still have all they can do. But, if the maintenance men are only shop repair men, who repair commutators, armatures, coils, contactor boards, etc., it would seem that they do not have enough to do.

There are so many factors entering into the operation and maintenance of motors as used in the various industries that each plant must be considered as a separate problem, and it would be unwise to consider a metal working plant and a food factory on the same basis. Are d.c. or a.c. motors used? Are sleeve-bearing or anti-friction bearings used? Are the motors overloaded? Must they run in dust and dirt? Do they operate continuously or may they be stopped for cleaning and adjustments? These and many other things must be known to be able to say if more than the three men should be employed.
D. W. BLAKESLEE.
Electrical Engineer,
Pittsburgh, Pa.

TO DETERMINE the number of men required to properly service a given number of motors as requested by S. Y. K. in the September issue, several factors must be considered, namely: (*1*) Ability of electrician as an inspector, (*2*) accessibility of equipment, (*3*) operating conditions, (*4*) type of motors and control.

The writer has in mind one plant where one man working 10 hr. per day maintains over 300 a.c. motors from ½ to 75 hp. Another case in the same plant, one man and his helper are kept busy 10 hrs. per day maintaining 35 d.c. motors and their control.

In the first case all motors are on floor level, easily accessible, operate under normal starting and running conditions and compressed air is available at each motor for cleaning.

In the second case 20 motors and their controllers are located on cranes handling hot steel, the rest operate auxiliary rolling equipment. These d.c. motors operate under very severe conditions, have complicated controls and repairs and the inspection must be carried out during short-stop periods. These two cases are extremes, but serve to bring out the fact, that the number of men required depends on the conditions in the plant which often vary widely in similar plants. G. LINDGREN,
Hudson Valley Coke & Products Company,
Troy, N. Y.

Accuracy of Tachometer and Revolution Counter

Will readers please tell me of their experience in the use of hand tachometers as compared with the well-known revolution counter and stop watch? I want to compare the accuracy of the two methods, and also find out whether any tests have been made to determine the errors due to the human equation when using the revolution counter and stop watch. W.T.C.
Jersey City, N. J.

WHEN comparing the accuracy of the usual type of hand tachometer and revolution counter, as mentioned by W. T. C., it is necessary to take into account just how accurately one wishes to measure or test the speed. I have never found a speed counter that was actually in error; on the other hand the inaccuracy due to the timing and in the watch itself has amounted to as much as 5 per cent. Although this value is an extreme figure it was obtained during a test in comparison with a hand tachometer that had been carefully checked and calibrated. Naturally the advantage of being able to note any instantaneous change of speed by means of a tachometer is something that only this type can give.

On the other hand a tachometer must be carefully checked at frequent intervals, say at least once a week if it is in daily use and a general check should be made once a day if the instrument is used in testing work where there is much speed variation.

For making routine or load tests where the speeds remain fairly constant throughout the tests I have found that a speed counter is sufficiently accurate to, say, within 2 per cent, but where extreme constancy of speed is required nothing but some form of tachometer will do and it should be carefully checked.
C. O. VON DANNENBERG.
New York, N. Y.

Comment on D. W. Blakeslee's Reply to W. T. C.

IN HIS reply to W. T. C., D. W. Blakeslee very clearly shows the difficulty of obtaining exact results with the ordinary revolution counter, such as is generally used for testing the speed of machines. He has evidently developed a very clever technique in order to overcome the inherent difficulties of endeavoring to do several things at the same time.

As he points out, it is practically impossible for one to insert the center point of the revolution counter in the shaft end and read a watch or start a stop watch at the same time. When one person does one thing and another person does the other, there comes the difficulty of having the two people coordinate their movements.

There is available a counter which contains a clutch mechanism permitting the tester to insert the tip into the end of the shaft and then read the watch at leisure. When the watch has come to any starting point, a push on the end of the counter causes the clutch to engage and the counter begins to register; when the quarter of a minute, half minute, or full minute has passed, the counter is removed from the end of the shaft.

Of course, it is not really proper to compare a tachometer and a revolution counter. The revolution counter gives results accurate within one revolution. A good tachometer will give results accurate in some cases to within one-tenth of 1 per cent. At 2,000 r.p.m. this would be within two revolutions. The revolution counter, on the other hand, would be within one revolution or 1/20 of 1 per cent correct, but the advantage of the tachometer is that it gives instantaneous readings and shows fluctuations in speed. Each instrument, therefore, has its own separate field of usefulness. D. J. POST, JR.
Veeder-Root, Inc.
Hartford, Conn

NEW EQUIPMENT

For Plant Operation and Maintenance

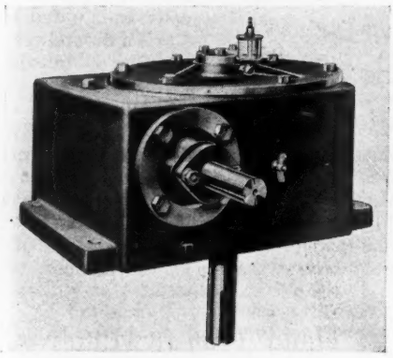
Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these new devices which are designed to improve plant operation or reduce operating and maintenance costs.

James Vertical Speed Reducer

AN IMPROVED vertical type heavy-duty worm gear speed reducer that is made to allow for vertical driving with the drive shaft projecting at either top or bottom, has been announced by the D. O. James Manufacturing Company, 1120 W. Monroe St., Chicago, Ill.

According to the announcement, the housing is of high-grade gray iron, of ample size, provided with a large oil-cooling and heat-radiating chamber. Timken bearings support both sides of the gear shaft, and make for smooth operation. The worm shaft is mounted on double Timken bearings on one side, and Norma Hoffman roller bearings on the other.

Gear shafts are .40 carbon steel, carefully ground to size, and made over-size to withstand emergency strains and starting loads. Worms are made integral, with worm shafts of S.A.E. 3140 chrome nickel steel, generated, heat-treated, ground, and fully relieved. Gears are made of high-grade phosphor bronze, the larger sizes made up of a bronze ring, shrunk on, and keyed to a cast-iron spider.

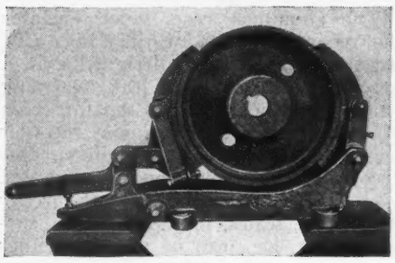


James Vertical Type Speed Reducer

Twenty-degree to thirty-degree pressure angle teeth are standard, depending on the number of teeth in the worm and gear, and all gears are made with amply wide spaces.

EC&M Hand Operated Brake

A NEW brake arranged for lever operation is now being built by the Electric Controller and Manufacturing Company, Cleveland, Ohio. This brake,



EC&M Mechanically Operated Type WB Brake

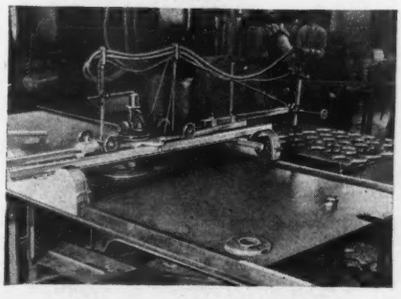
known as the mechanically operated type WB brake, is of the shoe type and is intended for the bridge drive of electric traveling cranes, lift bridges, electric hoists and other applications requiring foot operated or hand lever operated brakes.

This new brake is a modification of the EC&M type WB electrically operated brake; practically all wearing parts of the new mechanically operated brake are interchangeable with parts of the electrically operated type.

The tendency toward the use of anti-friction bearings on cranes and other machines has resulted in an increased amount of work to be performed by the brake, which must stop the moving crane or machinery unaided by bearing friction. Therefore, according to the announcement, the type WB brake is equipped with unusually thick molded asbestos brake shoes, requiring renewal only after very long periods of service.

Oxweld Shape-Cutting Machine

AN AUTOMATIC oxyacetylene shape-cutting machine designed to cut shapes of any sort from steel plate, sheet, forgings, billets or ingots is being introduced by The Linde Air Products Company, 30 East 42nd Street, New York. In this machine the cutting blowpipe is mounted on a carriage which is moved in any direction by means of an electric motor. For routine production it will operate automatically from templets. In cases where only a few parts are to be cut out a hand tracing device can be attached and used to follow the outline of a sketch or blueprint.

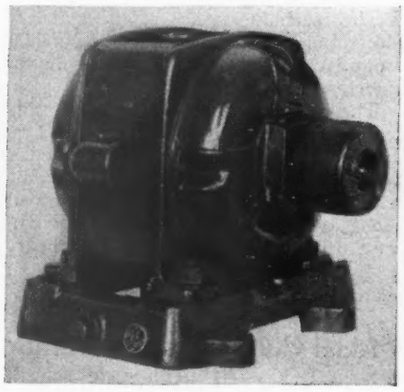


Oxweld Shape Cutting Machine

According to the announcement the Oxweld shape-cutting machine requires but one operator. Little machining is necessary in most cases after cutting because the parts are produced with straight corners and smooth faces. The speed of cutting is very high and ranges from 3 to 20 in. per minute, depending on the thickness of the metal. Accurate and smooth cuts can be made in stock up to 1 ft. and more in thickness. Production costs are reduced sharply owing to economies in labor, time and material.

G. E. Motors

AN IMPROVED single phase, repulsion induction motor has been announced by the General Electric Company, Schenectady, N. Y. This motor, in sizes including ¾, 1, 1½, and 2 hp. at 1,800 r.p.m., supplements the present General Electric line of S.C.R. motors. It is of the constant speed, high starting torque type for general application.

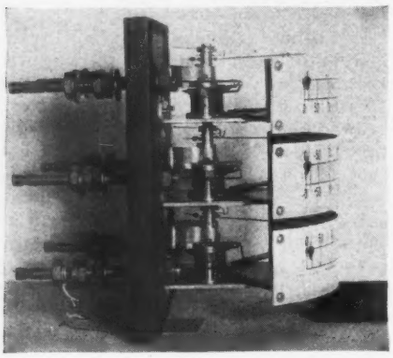


General Electric Company Improved Single-Phase Motor

According to the announcement, one of the most important improvements is the more efficient use of the stator punchings. The motor is inclosed except for ventilating openings in the lower portion of each end shield. Air is drawn through the ventilating openings at the pulley end by means of an internal fan, passes around the stator laminations, and out through the ventilating opening at the commutator end. This construction makes a practically inclosed motor, and provides complete protection against falling particles and splashing water. It is designed to operate within a temperature rise of 40 deg. This materially broadens the field of application, permitting the use of a standard 40 deg. motor in many cases where only a larger inclosed motor would otherwise be chosen.

Roller-Smith Polyphase Ammeter

TO SUPPLEMENT the Type B, triplex, three-phase ammeter, the Roller-Smith Company, 233 Broadway, New York, announce the Type HEA-3 ammeter for three-phase a.c. circuits.



Roller-Smith Company Type HEA-3 Ammeter

The Type HEA-3 ammeter consists of three horizontal edgewise mechanisms mounted one above the other in a single case and utilizing one window to permit simultaneous readings.

The mechanisms are of the standard electro-magnet type and so shielded from each other that there is no mutual interference.

The individual scales are the same length as those in the standard Type HEA meter. Accuracy, it is claimed, is within 1¼ per cent of the full scale value at any point on the scale. Base dimensions are 8⅜ in. wide, 9⅝ in. high with case projecting 6$\frac{29}{32}$ in. from the board.

Ideal Commutator Grinding Tool

MARKETING of the Perfect Tool Rest, which is a portable grinder to be used in conjunction with commutator grinding stones or resurfacers, has been announced by the Ideal Commutator Dresser Company, Sycamore, Ill.

According to the manufacturer, this tool has been especially designed for the removal of long flat spots and any eccentricities in commutators, and is light enough to be easily portable. Bases are available in lengths ranging from 6 in. to 28 in., in increments of 2 in. Bases 14 in. or shorter have two supports, whereas those 16 in. or longer have three supports. The supports are L-/or T-shaped for attaching to round brush arms; flat supports can be substituted when necessary to attach the tool rest to flat brush arms.

A large diameter wheel facilitates easy operation of the crossfeed and the bases are also provided with a screw infeed adjustment. This tool rest is designed to take cutting stones of 2 x 2-in. face or smaller, and of any convenient length.

Hays Boiler Panel

THE panel of boiler room instruments recently introduced by the Hays Corporation, Michigan City, Ind., consists of a U-shape of ¼-in. steel boiler plate with a metal inclosure for the top and hinged steel doors at the rear. The valves, pipes and wiring for the several instruments are conveniently accessible through these doors and yet they are protected and neatly concealed from view. Slate fronts can be used rather than steel if desired.

The aluminum case which encloses the recording parts of the Hays CO_2 Recorder has been so designed that it may be flush mounted, the analyzing parts being housed in a separate case at the rear. A companion recorder using the same type of aluminum case records steam pressure and temperature. The Hays Pointer Gage, with proper number of scales, for air pressure, furnace draft, etc., can be mounted either flush or semi-flush, depending upon the height above the floor. Any type of steam flow meter, it is stated, may be mounted on the boiler panel.

Hardware Products "Microhite" Hangers

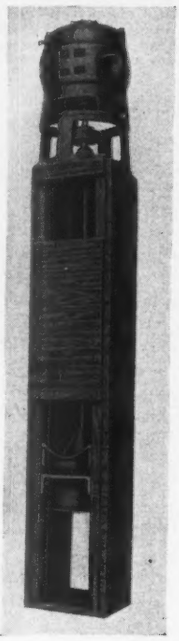
SELF-ALIGNMENT of the bearings in the hp Microhite hangers is permitted by freedom to move both in the horizontal and vertical planes. The hanger has been developed by the Hardware Products Company, 103 Richmond St., Boston, Mass., but will be marketed exclusively by the Boston Gear Works Sales Company, Norfolk Downs, Mass. Stock sizes range from bores of ½ to 1 in., and heights to the center line from 3½ to 10½ in. The range of bearings lengths is 2 to 2½ in. Both ball or bronze bearings, which are interchangeable, may be obtained.

After rough height adjustment has been made by sliding the shank in the base and locking it, the fine adjustment is made by the knurled collar which screws into the yoke.

Hardware Products Company Microhite Hanger

Screw Pump

A RECENT development in pumping equipment for handling large volumes of water at low head, is a self-contained vertical pump unit which has just been announced by Fairbanks, Morse & Company, 900 So. Wabash Ave., Chicago, Ill.



Fairbanks, Morse & Company Screw Pump for Low Head Pumping

According to the manufacturer, this pump unit is designed mainly for irrigation and drainage service, but it can be used for any type of pumping where the head is not over 8 feet and where a low installation cost is desired. It is called the Everglades screw pump. It is a vertical machine, consisting of cast iron spiders, carrying a Wood screw type impeller and diffuser, and constructed in such a manner that four wooden corner posts are fastened to the spider and the structure boarded up so that it may be placed vertically in a ditch or stream and arranged to discharge over the top of a levee or embankment. The pump is manufactured only in the 24-inch size. It is adapted for direct connection to vertical motors, for belt from motors or internal combustion machines, using a one-quarter twist belt or by means of a gear box at the top of the pump.

Hand Transfer Pump

A NEW fireproof hand transfer pump, for handling liquids of a volatile and explosive nature, has been introduced by the Geo. D. Roper Corporation, Rockford, Ill.

According to the announcement, this pump has a number of new features, among which are included an anti-drip spout of special construction to prevent dripping. A "Seal-o-matic" check valve immediately stops discharge of liquid from the spout when the operator stops turning the pump handle. A discharge nozzle is regularly furnished to fit openings from 1 to 5 gallon cans or containers. A return drip bowl is furnished through which drippings return to the drum and excess gases are allowed to escape. This acts as an automatic release valve for any excess pressure within the container. The bung screw is separate and independent from the pump, making it possible to turn the pump to any angle desired. This screw is furnished regularly for 1½- and 2-in. openings.

Pipe Wrench

THE introduction of a new and improved Trimo pipe wrench has been announced by the Trimont Manufacturing Company, Inc.

Although the contour of the frame has been slightly extended the appearance of a new Trimo remains practically unchanged and the parts of the old and new wrench are interchangeable throughout. According to the manufacturer, a new and scientifically developed method of heat treating gives to the handle greater strength and toughness than before. The swinging steel frame, though not materially changed in appearance, has been strengthened to such a degree that breaking is virtually out of the question even under the most trying conditions.

As a further safeguard, overlapping side lugs an integral part of the handle, places the frame effectively against the lateral distortion or spreading. The design of these reinforcing lugs furnishes a rugged safety feature without in any way hampering the action of the frame or adding to the bulk of the wrench.

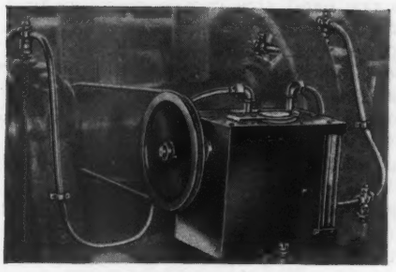
Blanchard Pulsating System for Oil Lubrication

AN automatic circulating system for oil lubrication of machinery has just been announced by the Rivett Lathe & Grinder Corporation, Brighton, Boston, Mass., under the name "Blanchard Pulsating System." The system is designed to operate without attention once it has been properly adjusted.

Oil is circulated from a central tank through a single closed circulating system in which are inserted as many feeders, singly or in gangs, as may be required. The pump, which is contained within the tank, starts and stops with the machine, keeps the oil circulating steadily at a pressure of about 10 lb. for 95 per cent of the cycle. Once every 15 revolutions of the pump the pressure control valve located in the reservoir is positively closed and remains closed for the remaining 5 per cent of the cycle. During this interval the pressure in the system builds up momentarily to 50 or 60 lb., and the spring loaded valve in each feeder is lifted off its seat. The amount of lift, and consequently the volume of oil being fed, depends on the loading of the spring controlling the feeder mechanism. This loading is adjustable. As the pressure control valve opens, the pressure in the system returns to normal and the feeder needles repeat themselves.

The reservoir mounted on the side of a machine is shown in an accompanying illustration. A gage glass is provided, and is protected by a metal guard rod.

The pump is a simple double-plunger unit with a piston valve, and it takes oil through a fine-mesh screen. There are no ball or other check valves in the pump. The shaft can be belted to or otherwise driven from any moving part of the machine, and can be driven in either direction, or reversing. Its speed range is from 75 to 125 r.p.m., and it should require no attention.



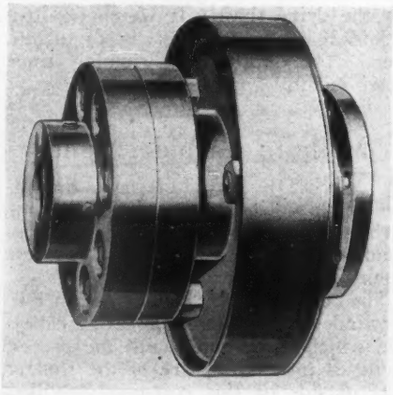
Blanchard Pulsating System for Oil Lubrication

The oil flow can be regulated by rotating the spring retainer, which has a slotted head. Anything from two or three drums per hour, to as small a stream as possible.

James Combination Automatic Back Stop and Flexible Coupling

BOTH the functions of the automatic back stop, to prevent reversal of travel and that of a flexible coupling are combined by this device, which has been placed on the market by the B. O. James Manufacturing Company, 1120 W. Monroe St., Chicago, Ill. The device is designed especially for use on elevator conveyors and process equipment drives where there is a likelihood of reversal of travel after the equipment has been standing idle. The back stop is applied on the driveshaft between the speed reducer and the motor. A flange, attached to the speed reducer housing is cast integral with the ratchet. The ratchet operates within a drum housing, which, in turn connects with the motor-shaft to a flexible rubber-type coupling. On the inner face of the housing, three pawls are secured by studs that engage the ratchet the moment the housing stops revolving.

The unit consists of a drum-chain housing, in the back of which is the half of the flexible coupling that contains free flexing live rubber bumpers in which Bound Brook oilless bushings are cemented. A half coupling fitted with hardened and ground steel pins which float inside of the graphite-impregnated bronze bushings, a ratchet plate, three pawls with studs, springs and fastening bolts, and a two-piece cover plate complete the unit.



James Combination Automatic Back Stop and Flexible Coupling

Centrifugal force keeps the pawls out of engagement with the ratchet during operation, but should anything happen to the shaft or motor, or should the motor be shut off, the pawls engage the ratchet through gravity and provide a break against reversal of travel of the elevator or driven machines.

Car Puller

THE No. 17-J Junior Model vertical capstan type car puller has recently been introduced by the Stephens-Adamson Manufacturing Company, Aurora, Ill. This equipment is said to meet the requirements of every need where a machine is required for pulling industrial cars out of long kilns, or for other purposes.

The machine is mounted on a rigid steel base made of riveted channel irons. The motor frame is bracket mounted to a steel plate, which is riveted to the channels to form part of the base. The bevel reduction gears are inclosed in the machine housing, which affords them excellent protection from abrasive substances.

One man operates the machine. A rope is hooked on to the railroad car and a few turns snubbed around the capstan of the car puller. The slack end of the rope is then tightened and the car puller moves the car at a rate of 30 ft. per minute. The capstan has a speed of 15 r.p.m., and exerts a 2,000 lb. rope pull. It is driven by a Westinghouse 5 hp. motor. The weight of the complete equipment is 1,075 lbs.

Battery Charger

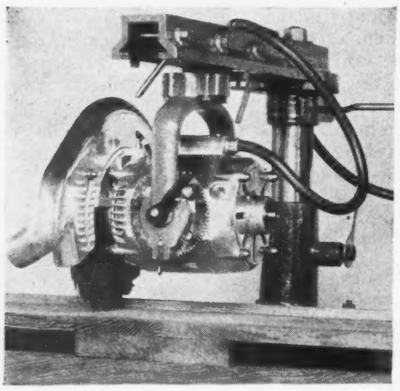
THE Merchandise Department of the General Electric Company, Bridgeport, Conn., has announced the addition of a new model—a six-battery Tungar—to its line of Tungar battery chargers. The features of this charger include increased capacity and charging rate, greater efficiency, lower price and several improvements in design and equipment.

This six-battery Tungar charger weighs only 29 lb., and has a charging capacity of six, three-cell batteries, or their equivalent, at 6 amp. The ammeter is contained in a Bakelite case and has been redesigned so that it is now easier to read. A new design of current control makes current regulation simple. The tumbler switch controls both alternating- and direct-current circuits.

This charger consumes approximately 400 watts at full load.

De Walt Portable Motor-Driven Saw

MARKETING of a portable motor-driven saw, known as the "Wonder Worker," has been announced by the De Walt Products Company, Leola, Lancaster County, Pa.



De Walt "Wonder Worker" Portable Motor-Driven Saw

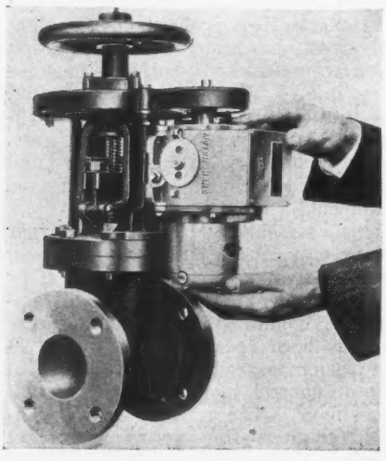
The machine comes fitted on a handy wooden table which can be placed upon wooden horses or on a small truck to move about the plant. Since it operates from one side of the table only, it requires very little floor space. It is direct driven, and may be powered with 110-220-volt a.c. or d.c. motors of from 1 to 8 hp. in capacity, and it will handle material, it is claimed, up to 6 in. in thickness and 24 in. in width.

The saw can be swung to any angle, right or left, raised or lowered, or tilted for compound angles.

Cutler-Hammer Motor Driven Valve Operating Unit

A NEW motor driven valve operating unit, which makes possible automatic operation of all valves up to six inches, has just been announced by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Although so small that it can be held in one hand, this unique operating unit has a rating of 15 lb. ft. It can be operated automatically by means of float switches, temperature controlling devices, pressure regulators, etc., or by conveniently located push buttons.



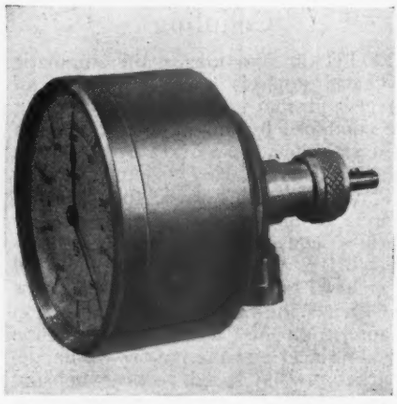
Cutler-Hammer Motor Driven Valve Operating Unit

Although designed primarily for valve operating service in industries where regulation of pressures and temperatures of gases and fluids is necessary, it is likewise adaptable to many miscellaneous applications, such as operating skylights, awnings, radiators, garage doors, etc.

Crane "Hasler Tel" Running Time Meter

A NEW recording device called the Hasler Tel running time meter, which, it is claimed, records the actual productive time, for a day, week, month or year, of any type of mechanical equipment, has been introduced by R. W. Crane & Company, Inc., 136 Liberty Street, New York, N. Y.

This device, according to the announcement, can be driven from any rotating member of a machine, and registers with equal accuracy in both directions of rotation, at any speed of rotation for any type of operation whether uniform or variable, constant or intermittent. It registers and totalizes automatically and is read like a clock.



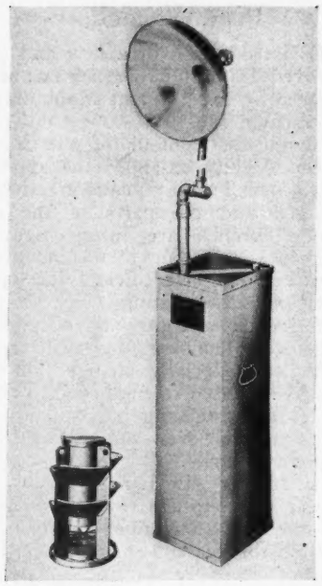
Hasler Tel Running Time Meter

It requires no attention beyond an occasional twist of the grease cup lubricating the drive shaft. It weighs 28 oz. and is 3½ in. in diameter by 2½ inches deep. The Hasler Tel running time meter is fully guaranteed for one year.

Milburn Carbide Light

A CARBIDE light of new design, which will operate with either lump carbide or carbic cakes, has been announced by the Alexander Milburn Company, Baltimore, Md.

The center of the carbide container is a cylinder which holds the carbic cakes, and which is equipped with the proper facilities for taking care of the sludge. The outside of this container is filled with conical pockets for the reception of ordinary carbide.



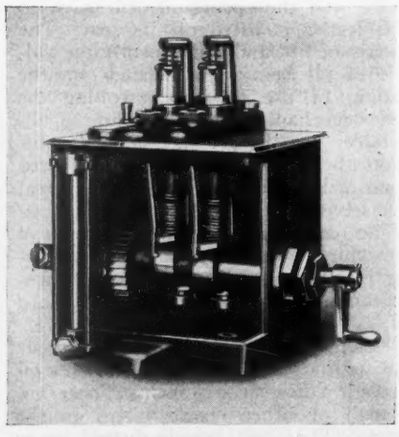
Alexander Milburn Company Carbide Light

It is further stated that in designing the new light, the same features which characterized the standard Milburn light have been retained, such as the fact that the Milburn light cannot be overcharged; it can be recharged without changing the water; as the automatic burner cleaner which cleans the burner, while the light is burning, and low operating cost.

American Forced Feed Lubricator

A NEW forced feed lubricator, known as the model F, has been introduced by the American Oil Pump & Tank Company, Cincinnati, Ohio.

The lubricator outfit, consisting of an oil storage tank on which is mounted individual pumping units for each oil line, results in an oiling system that is entirely automatic. As the lubricator is operated from some moving part of the machinery being lubricated, it conse-



The American Oil Pump & Tank Company's Model F Lubricator

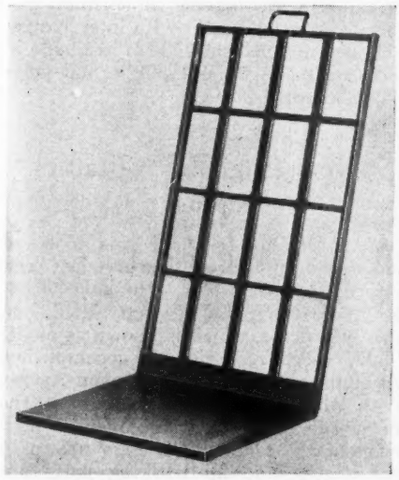
quently does not have to be started or stopped by hand.

Oil is pumped only when the machinery is in operation and when lubrication is required.

One pumping unit is used for each feed and is entirely separate and removable from the reservoir. The feed is regulated by adjusting the stroke of the plunger. A hexagon shaft runs lengthwise to the reservoir and is fitted with a cam for each pump unit. As this shaft is rotated, the cam raises the plunger on the delivery stroke, and permits the spring acting through a plate to lower the plungers on the suction stroke. The plate and plunger are raised to the same height at all adjustments of the stroke.

American Hand Truck Platform

A RACK or Truck-Pak as it has been named, which, it is claimed, gives to ordinary hand trucking equipment a flexibility comparable to that supplied by tractors, lift trucks, and skids, has



The American Pulley Company Truk-Pak

been introduced by the American Pulley Company, 4200 Wissahickon Avenue, Philadelphia, Pa.

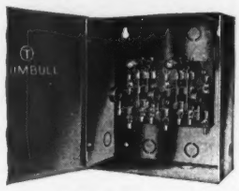
This Truk-Pak is made entirely of pressed steel. The deck is a steel plate welded to two steel forgings. These are bent upward and are welded to the inside of a channel platform, the back or uprights of the Truk-Pak. Cross bars are of channel section and the longitudinal straps are flanged to impart greater stiffness. The deck is raised far enough above the floor to make room for the truck nose to enter without lifting or disturbing the load. All joints and intersections are welded.

According to the announcement, the dimensions of the Truk-Pak, 28 in. wide by 48 in. high, make this rack suitable for use with almost every style and size of hand truck. They are intentionally proportioned so as to stand upright, either loaded or empty, and to be nested in stacks when not in use.

Trumbull Meter Testing Switch

THE meter testing switch for use with current or potential transformers, 30 amps., 250 volts, is now being marketed by the Trumbull Electric Manufacturing Co., Plainville, Conn.

This device consists of a slate base



Trumbull Electric Manufacturing Company Meter Testing Switch

test block inclosed in a steel cabinet. The top end of the cabinet is regularly equipped with a shutter containing knockouts for all standardized meters, including polyphase.

The test block itself consists of three single pole switches which control the current to the potential coils of the meter and two double pole switches which control the current to the current coils of the meter. The latter switches have an auxiliary jaw by which the current transformer is short-circuited when the switch is open.

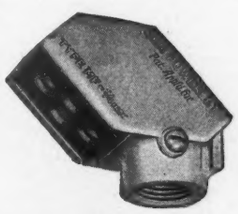
The arrangement of switches is such that the front cover cannot be replaced without first closing the switches.

Chicago-Jefferson Entrance Fitting

EASE of assembly, maximum wiring space, and only one locking screw are features that have been stressed in the new type "MF" Gem Powerlet service entrance fitting just announced by the Chicago-Jefferson Fuse and Electric Company, 1500 South Laflin Street, Chicago, Illinois.

The assembly is simple. Screw the base on to the conduit. When the cap is removed, the wires can be pulled through the conduit with a straight line pull. Pass the wires through the cover and replace the cap. One brass screw, which is not removable and cannot be lost, locks the cap cover and base firmly together.

The cap is designed to mount in both



Chicago-Jefferson Service Entrance Fitting

vertical or horizontal positions without removing the composition or twisting the wires. The covers have two holes and two knock-outs, permitting the use of 2, 3, or 4 wires.

Benjamin Spring Clamp Globe Holder

A NEW spring clamp globe holder replacing the old style screw holder on all Benjamin Glassteel Diffusers, has been announced by the Benjamin Electric Manufacturing Company, 120-128 So. Sangamon Street, Chicago, Ill.

According to the manufacturer the new spring clamp arrangement is extremely simple, consisting of only a cadmium plated wire band gripping over 75 per cent of the globe's neck and terminating in a tension clamp requiring only one motion to release. Time and effort required to remove the Glassteel diffuser globe has been reduced more than fourfold by this new holder.

Square D Panelboards

A NEW line of panelboards, lighter and less bulky than former types, and distinguished by many exclusive features, was recently announced by the

Square D Panelboards

Square D Company, Detroit, Michigan.

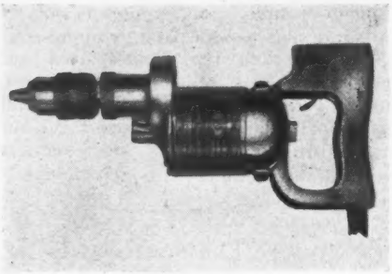
According to the announcement, Bakelite in walnut color is used for all molded parts, which are 21 in number.

New and exclusive design has also been employed in the main switches of 60, 100, and 200 amp. capacity. Tumbler switches are 30 amp., 250 volt rating of the heavy-duty types, easily removable from the front. Brush switches are of 250 volt rating, heavy-duty type. All metal parts are rust proof.

The plug fuses and cartridge fuses are interchangeable. On door-in-door safety types no screws or removable parts are exposed when the door is opened at the switch handles. All standard panelboards have a four inch gutter on all four sides, and fit in a code gage, galvanized steel cabinet which is 19 in. wide.

Wodack Portable Electric Drill

A PORTABLE electric drill particularly adapted for general repair work has been brought out by the Wodack Electric Tool Corporation, 4627-4629 W. Huron St., Chicago, Ill.



Wodack Electric Tool Corporation ⅜-in. Portable Electric Drill

This general purpose tool has a capacity of ⅜ in., weighs 7 lb., and is powered with a GE universal motor of the latest variable-type controlled by a trigger switch, 100 per cent oversize.

Besides drilling, it can be used for buffing and grinding. A stand can be furnished for holding the drill vertically and horizontally for grinding and buffing.

General Electric Heavy-Duty Oil Circuit Breaker

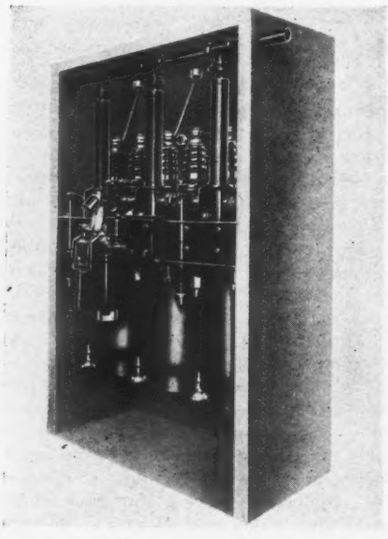
THE General Electric Company, Schenectady, N. Y., announces a new line of heavy-duty oil circuit breakers for indoor service on power systems of large capacity. These are known as the Types FK-330 and FHK-330.

The breakers are constructed of plate steel. They are simple to install, easy to inspect and can be furnished for either frame-work or cell mounting. The FK-330 breaker has plain break contacts while the FHK-330 employs the explosion chamber principle.

The explosion chambers are also made of steel. They are attached to the lower ends of the conductors which pass through the breaker bushings and are surrounded by insulating tubes.

The bushings used in the new breakers are of the so-called solid type. Two kinds are used, the porcelain and the "Herkolite." The former are provided in breakers of all ratings except the 3,000- and 4,000-amp. sizes of 7.5 and 15 kv., in which the Herkolite bushings are supplied.

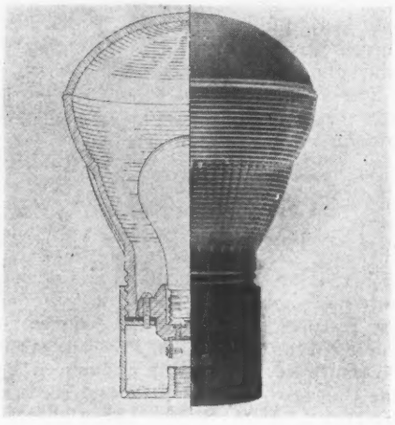
Electric operating mechanisms only are used with the new breakers. These mechanisms may be either the solenoid or the motor type.



General Electric Company Heavy-Duty Oil Circuit Breakers

Holophane Boundary and Obstruction Light

THE New Department of Commerce Standard Boundary and Obstruction Lights have been announced by the Holophane Company, 342 Madison Avenue, New York, N. Y.



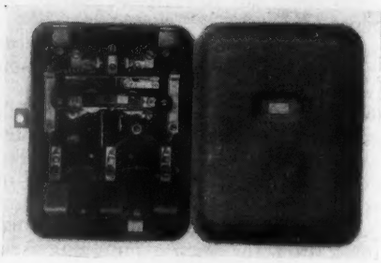
Holophone Boundary and Obstruction Light

These are special screw type globes with refracting prisms on the inside of the globe. The intensity of the light is increased in all upward directions. No. 02203 is the small size for lamps from 15 to 50 watts. No. 02323 is the large size for 100 and 150 Multiple lamps and 600-1,000 lumen series lamps.

Both globes are made of Crystal, Red, Green and Amber Glass. An engineering folder describing these globes and giving photometric curves will be sent to those interested.

Diamond Magnetic Switch

A MAGNETIC switch, combining needed features of roominess, accessibility and ease of installation has just been placed into production by the Diamond Electrical Manufacturing Company, of Los Angeles, Calif.



Diamond Type KXR Magnetic Switch

This latest switch, to be known as KXR Type, has been designed to connect directly across-the-line in starting, and is adaptable to the control of single and polyphase squirrel-cage induction motors.

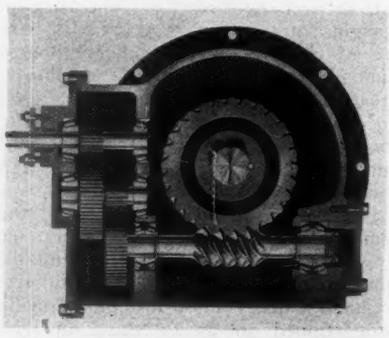
Wiring space has been provided in the cabinet behind the panel, giving ample room for all wiring requirements. Knockouts are provided on all sides and on the back so that cable installations can be made very easily and quickly.

All contacts may be easily removed from the front of the panel without disturbing the wiring. The switch is provided with inverse time limit and thermal overload relay with interchangeable heating elements. It is available in sizes up to 7½ hp. for single and polyphase motors.

New England Agitator Reducer

AN AGITATOR drive said to be of new design throughout has just been offered by the New England Tank & Tower Company, Everett, Mass. In this new drive, which is known as model T-37, speed reduction is accomplished through a combination of spur gears with what is claimed to be a new type of worm and gear which insures high efficiency. Timken bearings are used throughout and all working parts are operated in a bath of oil. In designing the housing particular attention was paid to the problem of heat radiation.

Among the other features is a positive oil trap that prevents oil from running down the vertical bearings and the wide spacing of the two vertical bearings which makes for stiffness of the vertical shaft.

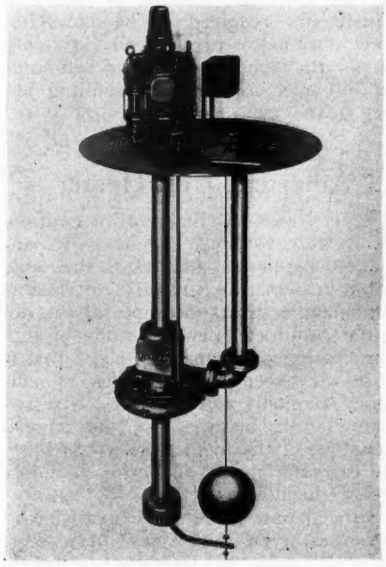


New England Model T-37 Agitator Reducer Drive

American Sump Pumps

THE American Well Works, 110 N. Broadway, Aurora, Ill., has just announced the marketing of a new improved line of sump pumps having many advantages over the old type.

The Type M.M.D. sump pump differs from other motor-driven pumps in that it employs a hollow-shaft motor in place of the old solid-shaft type. This construction makes possible a simple compact pump. By this construction, flexible couplings and thrust bearings are eliminated. The pump shaft extends up through the motor shaft, hence both motor and pump use the same thrust bearing which is mounted in the upper



American Well Works Type M.M.D. Sump Pump

end of the motor making adjustment very easily.

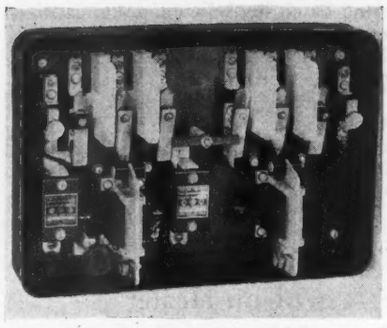
The pump shaft bearings consist of removable bushings. The pit plate is made of plate steel and is furnished either round or square. Pump may be had for all standard settings up to 17 ft. in either single or duplex units.

All units are furnished complete with float control switch, oiling device and motor.

G. E. Across-The-Line Reversing Switch

DEVELOPMENT of a control switch suitable for reversing small a.c. motors that are thrown across the line, is announced by the General Electric Company, Schenectady, N. Y. It consists of two triple-pole, barrier-type, magnetically-operated contactors, mechanically and electrically interlocked, and two hand-reset temperature overload relays mounted on a molded base and enclosed in a drawn-shell case. Designation CR-7009-B-12 has been assigned to this switch.

The double-break contactors with



General Electric Motor Reversing Switch

silver contacts, operated by a high-speed solenoid, it is claimed give the switch a very high interrupting capacity with minimum arcing.

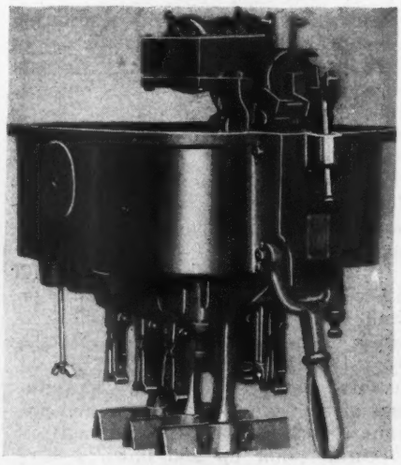
The two temperature overload relays protect the motor from overheating because of mechanical overload or single-phase operation. These relays are a fixed part of the switch, but have interchangeable heaters. To adapt this switch for use with a motor of a different rating but the same voltage, it is merely necessary to select heaters corresponding to the motor current.

Westinghouse Oil Switch

A NEW oil circuit breaker known as type F-10, applicable to 750- and 2,500-volt circuits, and having a current carrying capacity of 200 and 300 amp., has been announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

This breaker is furnished in two-, three- and four-pole combinations, and is either automatic or non-automatic as desired.

The automatic breaker has an interrupting capacity of 5,000 amp. on the 200-amp. breaker, and 7,500 amp. on the 300-amp. breaker at rated voltage. The frame, which has openings for taking leads down the two sides of the breaker, or out through conduit knockouts on the sides and back of the breaker, is con-



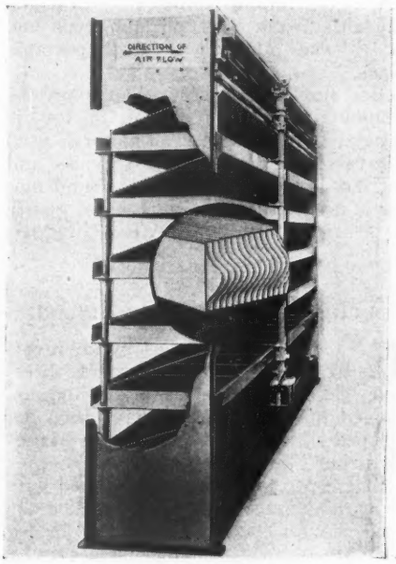
Westinghouse 200 Amp. Oil Circuit Breaker

structed of heavy cast iron, and arrangements are made for indoor mounting on either wall, frame, or structure.

Each contact of this new breaker is divided into two parts, one being the arcing portion and the other the main current carrying part of the contact. The parts are so located that there can be no arcing on the main current carrying part of the contact. All current carrying parts are easily accessible and are replaceable.

Midwest Sinuous-Type Air Filter

MIDWEST Air Filters, Incorporated, Bradford, Pa., announce a new air filter incorporating a new type of filter medium, and known as the Sinuous Type Air Filter. The manufacturers



Midwest Air Filters Incorporated Sinuous Type Air Filter

claim that this radical improvement cuts down the cost of filtered air to one-half or one-third what it was with earlier types. In explanation, they say that "the energy used in accelerating the air flow is not dissipated as in the multi-baffle, uncontrolled air flow filters, but is regained by application of the venturic principle and transmitted to the outer air stream."

Trico Colored Plug Fuses

A PRACTICAL color scheme in plug fuses has been developed for electric light circuits by the Trico Fuse Manufacturing Company, Milwaukee, Wis.

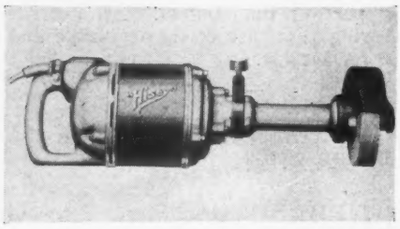
These fuses bear a distinct color for every size: 0 to 6 amp. brown, 10 amp. yellow, 15 amp. blue, 20 amp. pink, 25 amp. red and 30 amp. green.

It is assumed in replacing fuses that users remember colors more easily than figures.

Hisey-Wolf Portable Grinders and Buffers

PORTABLE grinders and buffers of a new design have been announced by The Hisey-Wolf Machine Company, Cincinnati, Ohio.

These grinders are available with



The Hisey-Wolf Machine Company Portable Grinder and Buffer

ball-bearing motors and Timken roller-bearing grinding spindles in various capacities: the ½-hp. portable type and 1-, 2- and 3-hp., heavy-duty portable types.

For single-phase service an improved commutating-type repulsion motor is standard. A squirrel-cage motor is used for two- and three-phase services and for d.c. service a compound-wound motor is used. The cast-steel wheel guard, it is said, conforms to A.E.S.C. standards.

Trumbull Entrance Switch

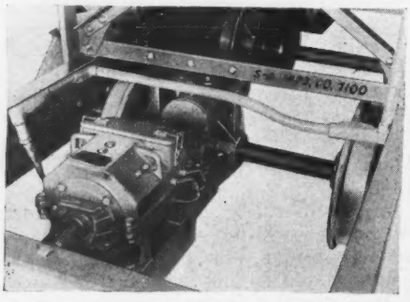
ENTRANCE switches with reversible end plates, two- and three-pole, 30-amp. 125-volt rating and arranged for single fusing have been developed by the Trumbull Electric Manufacturing Company, Plainville, Conn.

These two switches may be used with or without meters as desired. The top ends contain conduit knockouts, one for use with standard 15-amp. meters and a twistout for attaching special hood-type meter trims required in certain localities. When using, simply remove two screws and reverse the top end plate, then remove the large twistout allowing the special meter trims to slide into place.

Stephens-Adamson Car Drive

FOR such industries as the glass, cement, ore smelting, chemical, etc., where self-propelling scale cars are used as a rapid and reliable means for collecting batch ingredients, a standardized method of drive has been developed by the Stephens-Adamson Manufacturing Company, Aurora, Ill.

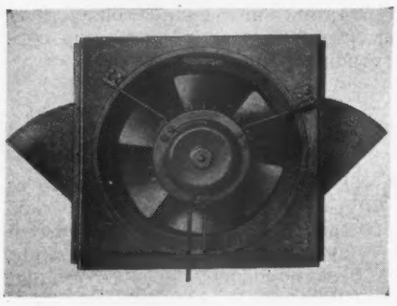
Three drive sizes have been developed which can be used to drive practically any car. The chassis shown is equipped with a 6½-hp., mill-type motor having Timken bearings.



Stephens-Adamson Manufacturing Company Scale Batch Car Drive

Sturtevant "Tempervane" Unit Heater

B. F. STURTEVANT COMPANY, Hyde Park, Boston, Mass., have recently put on the market a new line of unit heaters called the Sturtevant Tempervane Heater. These are available in floor and overhead types and are designed to withstand steam pressures up to 350 lb. per sq.in. The manufacturers claim that for any given air delivery or B.t.u. capacity these heaters require a motor of only one-half the horsepower required for similar units which are equipped with housed



B. F. Sturtevant Company Tempervane Unit Heater. (Rear view)

centrifugal fans. Because of this feature, it is asserted that these units operate at a current saving of 50 per cent as compared with other types of unit heater.

Benjamin Motor-Driven Signal

A MOTOR-DRIVEN signal of remarkable carrying and penetrating power, particularly desirable for use in such locations as steel mills, railroad shops, foundries, cotton mills, screw machine departments, and machine shops, where a signal must compete for attention with excessively loud manufacturing noises, has been developed by the Benjamin Electric Manufacturing Company, 120-128 S. Sangamon Street, Chicago, Ill.

This signal is equally well adapted for either outdoor or indoor installation. Both Single- and Double-Horn Projector Types are available. Catalog No. 8180, Double Projector Type, illustrated, is outstanding for its usefulness in furnishing an effective and economical means of projecting sound from a central point up and down a long, narrow structure, passageway or platform.

The Benjamin Electric Manufacturing Company Double Projector Type Motor-Driven Signal

The use of rubber gaskets is said to insure absolute weather-proof qualities; and the minimum amount of care and adjustments required. The powerful, heavy-duty motor rarely needs adjusting oftener than once a year and self-feeding oil wick cups require refilling but once in the same period.

American Unit Heater

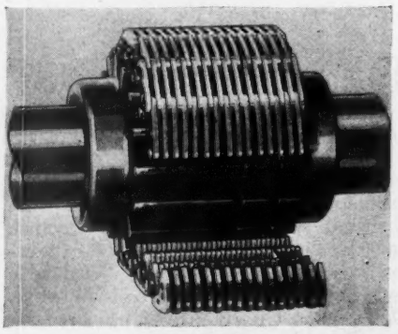
THE American Blower Corporation, Detroit, Mich., has recently announced the newest addition to their line of unit heaters: the Sirocco Unit Heater. The manufacturers present this model as the result of intensive study of factory heating problems, and claim that it possesses exceptional features of efficiency, economy and long life. Stressed among these features are the rugged mounting of the motor, the accessibility and ease of removal of the fan assembly and of the heater elements.

Sirocco unit heaters are available in capacities, types and sizes for a wide variety of industrial building heating requirements.

Morse Flexible Coupling

A FLEXIBLE coupling which consists primarily of a chain wrapping two sprockets has been introduced by the Morse Chain Company, Ithaca, N. Y.

Two sprockets are used, each one-half the width of chain; one with guide grooves in the center of the face to hold the chain in place, and the other free to float under the chain without the guide. The chain fits loosely enough on the sprockets to take care of ordinary misalignment.



Morse Chain Company Flexible Coupling

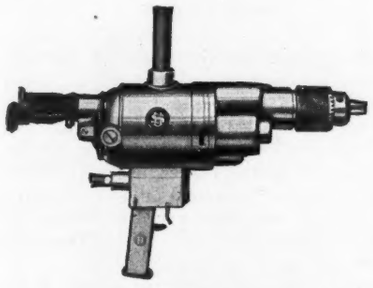
Jones Semi-Steel Pulleys

THE W. A. Jones Foundry & Machine Company, 4401 West Roosevelt Road, Chicago, Ill., have recently put on the market, after exhaustive tests, a complete line of semi-steel pulleys. According to the manufacturers, this is a material improvement over the old type, cast-iron pulley, without increase in cost. It is claimed to be stronger, better looking, close-grained and free from defects; being a solid cast unit, it is said to be free from the tendency to become wobbly in use, and to be practically wear-proof. This pulley is available in sizes from 2-in. to 60-in. diameter and from 2-in. to 50-in. face in solid type, and from 6-in. to 60-in. diameter and 3-in. to 50-in. face in the split type.

U. S. Electrical Tool Co. ¾-In. Heavy-Duty Drill

IN RESPONSE to demand for a powerful, low-speed, ¾-in. heavy-duty drill for continuous, heavy-duty service, the United States Electrical Tool Company, Cincinnati, Ohio, now has quantities in the hands of jobbers and supply houses.

A universal motor, operating on 60



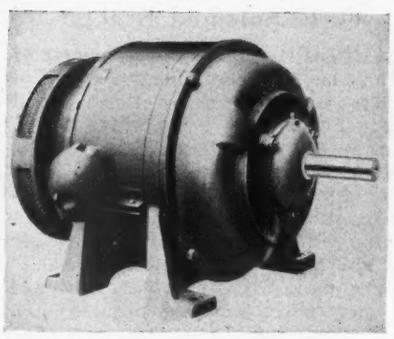
U. S. Electrical Tool Company ¾-In. Heavy-Duty Drill

cycles or less, pulls this drill at 350 r.p.m. load speed. In all other respects, it is typical of U. S. drills: SKF ball bearings, chrome nickel steel gears, hardened, running in grease: double silk insulated, enameled, armature wire: one-piece, aluminum body frame and commutator head: quick make, quick break, two-pole trigger switch: three-jaw screw back chuck for straight shank dr"l bits. This model weighs 27 pounds.

Reliance Inclosed Fan-Cooled Motor

ANNOUNCEMENT has been made of the development of the Type AA, fully-inclosed, fan-cooled induction motor by the Reliance Electric and Engineering Company, 1042-1090 Ivanhoe Road, Cleveland, Ohio.

Two kinds of construction are used; the smaller sizes have riveted-type frames, the larger sizes skeleton-type frames.



Reliance Electric and Engineering Company Type AA, Induction Motor

In the skeleton-type shown a single exhaust fan is mounted on the shaft-extension outside the bearing bracket. Air is drawn in through openings at the center of the back bearing bracket and exhausted at the front end.

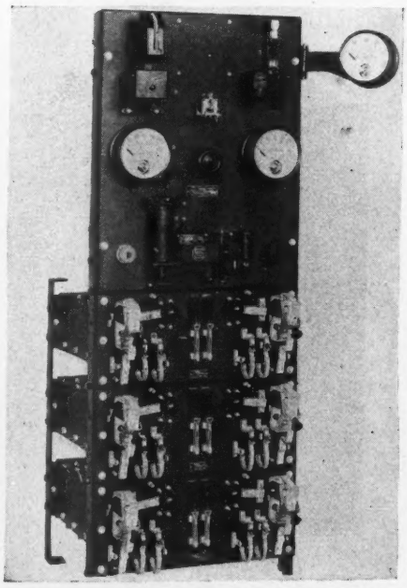
These motors are equipped with ball bearings, and they are available for two- and three-phase a.c. circuits. They are for use where motors are exposed to much dirt, iron dust or moisture.

G. E. Charging Panel

A NEW control panel, announced by the General Electric Company, is designed for charging six vehicle batteries, each of the 42-cell, 13-plate type. The panel is for use in conjunction with a motor-generator set consisting of a 27-kilowatt, 110-volt generator driven by a 40-hp., 550-volt, three-phase, 60-cycle motor.

In conjunction with a magnetic starter for the motor, the panel provides overload protection for the generator, restarting of the set and resumption of charging after line failure and full automatic shut-down after completion of the charging of the batteries.

On the generator section of the panel



G. E. Panel for Charging Six Vehicle Batteries

are mounted a snap switch for controlling the magnetic starting switch; a tumbler switch for full-automatic shut-down; a field rheostat; a voltage regulator; an overload and shunt-trip circuit breaker with a circuit opening auxiliary switch; auxiliary and line contactors, and an ammeter and a voltmeter.

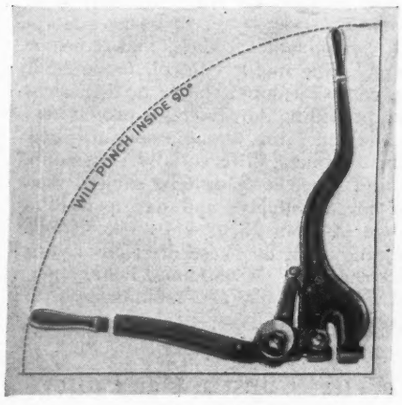
The charging sections of the panel incorporate a new development. The double-pole battery contactors are equipped with a shunt-holding coil and operate with ampere-hour meters having "quick break" contact.

Each contactor also has a normally-closed interlock.

Each charging circuit also includes an ammeter-voltmeter switch for reading charging current and voltage; a single-pole, single-throw lever switch for boosting the charge; a pilot light to indicate when a battery is plugged to the panel, and a fuse for short-circuit protection.

Whitney Metal Punch

A NEW, lever-type punch designated as the No. 7½ has been added to the line of the Whitney Metal Tool Company, Rockford, Ill. This punch is an exact division between the No. 7 and

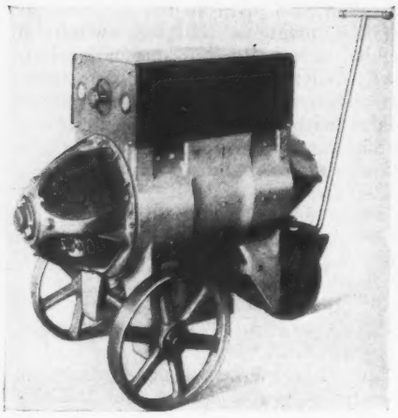


Whitney No. 7½ Imperial Roller Bearing Punch

No. 8 models of this company's lever-type punches in weight, capacity and price, the capacity being a ¼-in. hole through $\frac{3}{16}$-in. plate. In common with its companion models, the handle of the No. 7½ punch is arranged for punching standing seams or inside of 90 degrees.

Westinghouse Arc Welder

THE 300-amp. d.c. arc welder is one of the most recent developments made by the Westinghouse Electric and Manufacturing Company. The welding unit was designed and constructed for heavy-duty work, and continuous economical service in the shops, and in the field where only direct current is available for driving motor. This set, according to the announcement, is particularly applicable where the all-day load exceeds 200 amp. The driving motor and the generator are inclosed in



Westinghouse Heavy-Duty D.C. Arc Welder

the same frame, while the control is mounted on top, being in a part of the frame, and protected by a sheet steel cabinet. A common shaft with a ball bearing at each end is used for the generator and driving motor. For use as a portable unit, three roller bearing wheels are attached to the frame—for stationary use, the running parts are omitted.

The driving motor is designed so that it can be used on either a 230-volt or a 550-volt line, being of a special type S.K. compound wound, and constant speed. The motor control, mounted in the control cabinet, is a starting rheostat providing low voltage protection.

The generator, a single operator, constant torque, differentially compound wound type, is separately excited from the motor supply, and has a welding range of from 75 to 400 amp. Simple welding control is secured by a one-dial rheostat. A 600-amp. meter and a 0-125-volt meter are mounted on the control panel.

Weller Capstan Car Pullers

THE Weller Manufacturing Company, 1820 N. Kostner Ave., Chicago, Ill., have designed two sizes of the Upright Capstan Type car pullers which are electrically operated. According to the manufacturer's description, the new type of capstan type car puller is a compact, self-contained unit, occupying very little space; easily operated, and practically fool proof; will pull in any direction or at any angle; operates at the touch of a button. The consumption of power and expense of operating are claimed to be very little.

The C-1 will develop full strength of 1¼-in. manila rope and will pull from 1 to 3 cars. The C-2 will develop full strength of 1½-in. manila rope and will pull from 3 to 6 cars.

A car puller installed does away with waiting for the switch engine and crew, also saves the time of the regular force who are usually compelled to stop their work and move the cars with pinch bars.

It is also adapted for other purposes such as moving cars in and out of kilns, moving heavy trucks and pulling materials around the yard or plant.

G. E. Solenoid Brakes

SIMPLIFICATION is the keynote of a complete new line of solenoid brakes now offered by the General Electric Company, Schenectady, N. Y. This line bears the designation CR-9516, and includes brakes for operation on alternating and direct current. It involves in its construction the use of a spring-setting device—a new feature for alternating-current applications.

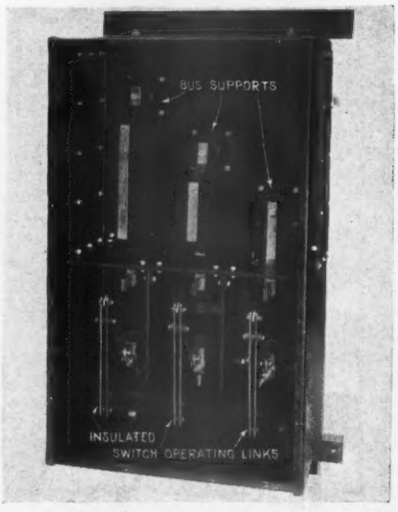
The brakes are especially designed for severe service in connection with mill, crane and hoist motors. The manufacturer claims smooth operation when making quick stops in either direction of rotation, with a dependable holding value. The brake mechanism is held in the off position by a coil and plunger; when power is applied to the motor, the coil is energized and the brake is released. When the power is shut off, the spring-setting device forces the mechanism into the closed or braking position.

Both alternating- and direct-current brakes use the same brake mechanism and frame, the solenoids being interchangeable.

Unusually small diameter brake wheels are used, minimizing flywheel effect and reducing WR^2 values. A wide wheel face gives ample braking surface. The brake shoes are of cast iron and are self-aligning, permitting, it is claimed, proper contact with the wheel even when the brake is incorrectly mounted and the wheel is out of line with the center line of the brake, both sidewise and up or down.

Delta-Star, 2,200-Volt Distribution Center

THE development of a 2,200-volt distribution center for industrial use has been made by the Delta-Star Electric Company, 2400 block Fulton St., Chicago, Ill.



Delta-Star Electric Company, 2,200-Volt Distribution Center

This unit is on the order of the sectional book case, using for each motor one steel box 48x24x14-in. containing three standard 7,500-volt bus supports and three 7,500-volt S.P. disconnect switches. The latter are provided with vertical transite barriers. The disconnects are gang operated by an insulated handle on the front of the box and are locked in or out.

The units are shipped assembled on the angles, complete with bus and pothead entrance at one end. The field work consists of mounting the assembled group of units and bringing in the feeder cable and motor leads.

Scully Valve Stem Guide Cleaner

THE Scully Steel & Iron Co. of Chicago, are putting on the market the Scully Ruggles Perfection valve stem guide cleaner. This cleaner is exactly the same in design as the well-known Ruggles Perfection flue cleaner which has been used for twenty-five years for removing carbon from boiler tubes in

Scully Ruggles Perfection Valve Stem Guide Cleaner

steam plants, but is intended for internal combustion engine valve stem guides.

The manufacturer claims that this tool cuts the carbon out and will not cut the metal; the spiral blades are self-sharpening; no hard physical labor is required to operate this cleaner; the cleaner is simply worked straight up and down by hand; no turning.

Only three cleaners are required for all holes from $\frac{7}{16}$-in. to $\frac{5}{8}$-in. The price is $2.00 net each.

Chicago Belt Conveyor Idler

A BELT conveyor idler with a number of improvements has been introduced by the Chicago Automatic Conveyor Company, 1845 South 55th Ave., Cicero, Ill.

The pulleys are spaced ¼ in. apart to avoid belt creasing. Heavy steel tubing is used for the pulleys, which have steel heads, electrically welded flush with the ends, eliminating dust pockets.

A unit mounting is used for the bearings to keep them in perfect alignment. The mounting also serves as a grease reservoir. Because of the large reservoir it is stated that the idlers will run from three to six months without attention. The bearings are positively protected from dust and grit by a quadruple labyrinth grease seal, which also prevents the grease from being thrown on the belt. Heavy cast iron brackets are used. They are accurately machined to avoid cramping the shaft, and can be mounted on either wood or channel base.

Lincoln Welding Electrode

ANNOUNCEMENT comes from the research laboratories of The Lincoln Electric Company, Cleveland, Ohio, of the perfection of a welding electrode which will be known as "Fleet-Weld."

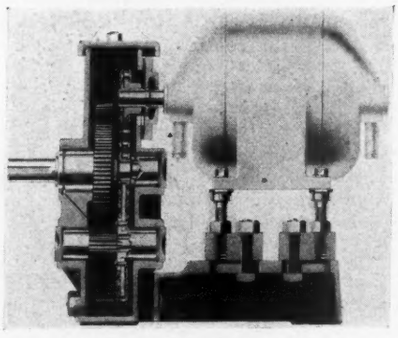
This welding rod it is stated, will produce a dense weld of greater ductility at greatly increased welding speeds. This increase in the speed of welding will, of course, be reflected in lower welding costs wherever the high-speed electrode is used.

An incidental advantage which the new electrode offers, is the smooth finish of its bead. This in part is caused by the higher speed of travel allowed by the new electrode and also is in part inherent in the composition of the rod.

The electrode itself is an extruded wire that permits high-speed welding without loss of denseness and ductility to the weld metal.

Cullman Speed Reducer

A SPEED reducer built into one unit, that is, motor and reducer combined into one machine to simplify installation has been announced by the Cullman



Cullman Wheel Company Speed Reducer

Wheel Company, 1344-54 Altgeld St., Chicago, Ill.

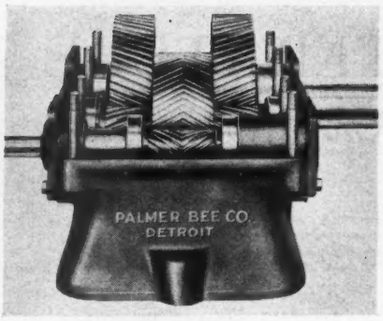
The housing, cover and motor base are of cast iron. Gears and sprockets are made of steel, hardened. Diamond standard roller chain connects sprockets. All bearings are phosphor bronze, shafts are made of steel, hardened and ground, running in oil. The motor is mounted on four adjustable studs.

They are available in sizes for motors of from ¼ to 5 hp., and for various speed ranges.

Palmer-Bee, Herringbone Speed Reducers

IN ORDER to meet the demand for more modern and efficient inclosed gear reduction units, Palmer-Bee Company, Detroit, Mich., has placed on the market a line of Herringbone speed reducers.

The Single Series Reducers have one pair of continuous-tooth herringbone gears. In the Double and Triple Series,



Palmer-Bee Company Double Series Herringbone Speed Reducer

the high-speed gears are continuous-tooth, herringbone type (Sykes generated) and the slow-speed gears are divided in the center, permitting an equal distribution of the load on each bearing.

Anti-friction bearings are used throughout; ball bearings on the high-speed, Hyatts on the intermediate and Timkens on the slow-speed shaft. The efficiency of the Single Series Reducers, it is stated, is about 99 per cent, and that of the Double Series approximately 97 per cent.

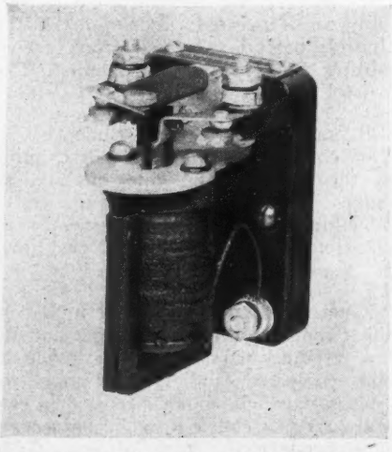
G. E. Signal Relay

THE CR-2904-F-1 relay announced by the General Electric Company, Schenectady, N. Y., is designed for application where a small, inexpensive device is needed to actuate a warning signal when power fails or voltage drops.

The relay is of the solenoid type, having a laminated armature composed of three sections, the central leg of which is fastened to a Bakelite operating arm which raises and lowers the contact tips. The entire device is mounted on a molded compound base, 1⅞ in. wide and 2½ in. high. It can also be supplied for panel mounting.

In operation, the coil circuit of the relay is connected across the two legs of the power supply. When the coil is thus energized, the relay contacts are held open. By connecting a circuit through the contacts to a bell, or other signalling device, warning will be given when power fails or voltage drops, as the contacts will close and complete the warning signal circuit.

The relay can be used on either direct or alternating current.



General Electric Signal Relay

Ruxton "Multi-Vider" Pencil

THE "Multi-Vider" pencil illustrated is a combination slide rule and automatic pencil, and is made by the Ruxton Multi-Vider Corporation, 2445 Graybar Building, New York, N. Y.

Its overall length is 6½ in. and it measures ⅞ in. across the flats of the hexagon barrel so that it can readily be carried in the vest pocket.

With it, rapid calculations can be made involving multiplication, division, percentages and proportions with sufficient accuracy for estimation purposes, and the result can be written down with the pencil in the hand. It is recommended for engineers, architects, contractors and business men who have estimates to make. A simplified instruc-

Ruxton "Multi-Vider" Pencil

tion booklet is furnished with each Multi-Vider pencil so that those unfamiliar with the slide rule can readily learn its use.

The Logarithmic scale is 4 in. long and is engraved by a precision machine. The hexagon barrel carrying the scales, of which there are four, is made of Bakelite for lightness and durability.

Dixon Graphite Seal

A NEW addition to their line of graphite products has been announced by the Joseph Dixon Crucible Company, Jersey City, N. J.

The new product is Graphite Seal. This is a graphite paste for sealing screw threads, flange and gasket joints of pipe lines carrying hot or cold oils, gasoline, etc. According to the manufacturer, this product is insoluble in oils and gasoline and will have many applications in oil fields and refineries, as well as extensive industrial uses on creosote, tar, vegetable and animal oil lines.

It is also added that this seal expands when subjected to heat and makes leak-proof joints that hold tight under all conditions of service. Yet these joints may be opened with ease at any time without delay or damage to tools or fittings. It is also recommended as excellent for use on hand hole and man hole plates or wherever there is a flange and gasket combination. Numerous other uses will be suggested.

TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog desired, as given in these columns.

CAST IRON—Part 1, entitled "High-Test Gray Iron, Introduction and Historical Review," the first of a series of papers on cast iron and its manufacture, by Dr. Edward E. Marbaker, has recently been issued.—Whiting Corporation, Harvey, Ill.

BALL BEARINGS—General catalog No. 28 contains 71 well illustrated pages devoted to a comprehensive study of the ball bearing and its application. The catalog also contains many tables and drawings of value to the user.—The Fafnir Bearing Company, New Britain, Conn.

CONTROLLER—Leaflet No. 20374, describes Class 13-300 motor-operated hand controller.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

MEGGER—Megger and Meg, direct reading Ohmmeters, designed for operation from an external source of direct-current, are described in a recently issued bulletin No. 1200.—James G. Biddle, 1211-13 Arch Street, Philadelphia, Pa.

ELEVATORS—184 bucket elevators of different styles and sizes with capacities from 6½ to 750 tons an hour are described and illustrated in the new bucket elevator catalog No. 465, now ready for distribution.—The Jeffrey Manufacturing Company, Columbus, Ohio.

KELVIN BRIDGE—Bulletin No. 434 contains an illustrated description of the students Kelvin Bridge, for use in the measurement of resistance.—Leeds & Northrup Company, Philadelphia, Pa.

RECORDING INSTRUMENTS — Strip-charts, recording instruments, Type CD and CDP in both alternating and direct-current styles, are described in bulletins G.E.A.-1061. — General Electric Company, Schenectady, N. Y.

CIRCUIT BREAKERS—The first of a series describing I.T.E. equipment that will make up a new catalog is No. 220 and covers U-Re-Lite all steel distribution groups. — I-T-E Circuit Breaker Company, Philadelphia, Pa.

BLOWERS—A booklet entitled "Improved Gas Producer Operation," and explaining how the Wing turbine blower improves the quality of the producer gas, and increases the gas output, has recently been issued.—The L. J. Wing Manufacturing Company, 154 West 14th Street, New York, N. Y.

ARC WELDING — Folder GEA-1022 contains a description and illustration of the GE automatic arc welder for steel railroad ties.—General Electric Company, Schenectady, N. Y.

SLACK PULLERS—Bulletin No. 702 contains 4 pages devoted to a description of Matthews slack pullers.—W. N. Matthews Corporation, St. Louis, Mo.

ELECTRICAL EQUIPMENT — Catalog No. 110A supplementing catalog No. 110 contains 68 pages devoted to a description of railway and industrial electrical equipment.—The Pyle National Company, Chicago, Ill.

MOTORS—Bulletin No. 6026 describes the Engberg line of roller bearing a.c. motors. These motors are made in the squirrel cage, polyphase, and induction types.—Engberg's Electric & Mechanical Works, St. Joseph, Mich.

THREADING HEADS—Catalog No. 30 contains illustrated descriptions of Land-Matic Heads, Landex Heads, Lanco Heads, Landis Chasers, the Landis Chaser Grinder and Victor Taps. — Landis Machine Company, Inc., Waynesboro, Pa.

ALLOYS — A small bulletin recently issued contains a brief history of the discovery, the development and some applications of the series of alloys known as Fahralloy. — Southern Manganese Steel Company, Inc., 6600 Ridge Ave., St. Louis, Mo.

RECORDING INSTRUMENT — Catalog 1900, superseding bulletin No. 310, contains an illustrated description of the Bristol long distance electrical transmitting and recording system. — The Bristol Company, Waterbury, Conn.

BUILDING EQUIPMENT—Bulletin WT-1003 contains an illustrated description of the Worthington line of building pumps and associated equipment.—Worthington Pump & Machinery Corporation, 2 Park Avenue, New York, N. Y.

OFFICE PARTITIONS—Bulletin B contains complete architectural data on the line of steel partitions being made by this company, and in particular the Steelpact panels which consist of a central core of Celotex to which is secured stretcher-leveled steel sheets.—Globe Wernicke Company, Cincinnati, Ohio.

OILING MACHINE—Form No. 381 describes the Gast oiling machine for use on loose pulleys and line shafts.—Pyott Foundry Company, 328 No. Saginaw Street, Chicago, Ill.

VIBRATION—"Vibration As Related to Industrial Lighting," by Allison J. Thompson, president, is the title of a 15-page booklet recently issued.—The Thompson Electric Company, 1348 West 9th St., Cleveland, Ohio.

SPEED REDUCERS—Catalog No. 166 describes, illustrates, and lists completely every type of speed reducer made—planetary spur (direct, angle, and verticle drive), heavy-duty worm (direct and angle drive), medium-duty worm (direct and angle drive), and herringbone (direct and angle drive).—The D. O. James Manufacturing Company, 1120 W. Monroe St., Chicago, Ill.

SILENT GEARS—The development, the design and manufacture of Fabroil and Textolite silent gears is described in detail in Bulletin GEA-482-A recently issued. This bulletin also contains descriptions of a number of applications and working data.—General Electric Company, Schenectady, N. Y.

CONTROL—Bulletin No. 500, No. 1 of a series, contains an illustrated description of the Leeds & Northrup system of automatic control of acid baths.—Leeds & Northrup Company, Philadelphia, Pa.

ELECTRICAL APPLIANCES — There has just been published a supplement to the April, 1928, list of Inspected Electrical Appliances. — National Board of Fire Underwriters, 207 East Ohio St., Chicago, Ill.

SPRINKLER EQUIPMENT — The 1928 edition, Regulations of the National Board of Fire Underwriters for the installation of sprinkler equipment, as recommended by the National Fire Protection Association, has now been printed and is ready for distribution.—National Board of Fire Underwriters, 207 East Ohio St., Chicago, Ill.

DOOR FRAMES AND TRIM — A new folder containing simplified practice recommendations R82-28 is now ready for distribution.—Department of Commerce, Bureau of Standards, Washington, D. C.

CRUSHERS — Bulletins Nos. 2003 and 2004 describe the Pennsylvania line of Penn - Lehigh single - roll crushers. — Pennsylvania Crusher Company, Liberty Trust Bldg., Philadelphia, Pa.

MOTORS — Wagner large RA single phase, repulsion-induction motors are illustrated and described in detail in bulletin 157.—Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo

METERS—Bulletin 4D contains a brief history of the development of the double impeller type of blower or pump, and of the rotary displacement meter.—The Connersville Blower Company, Connersville, Ind.

DECEMBER, 1928

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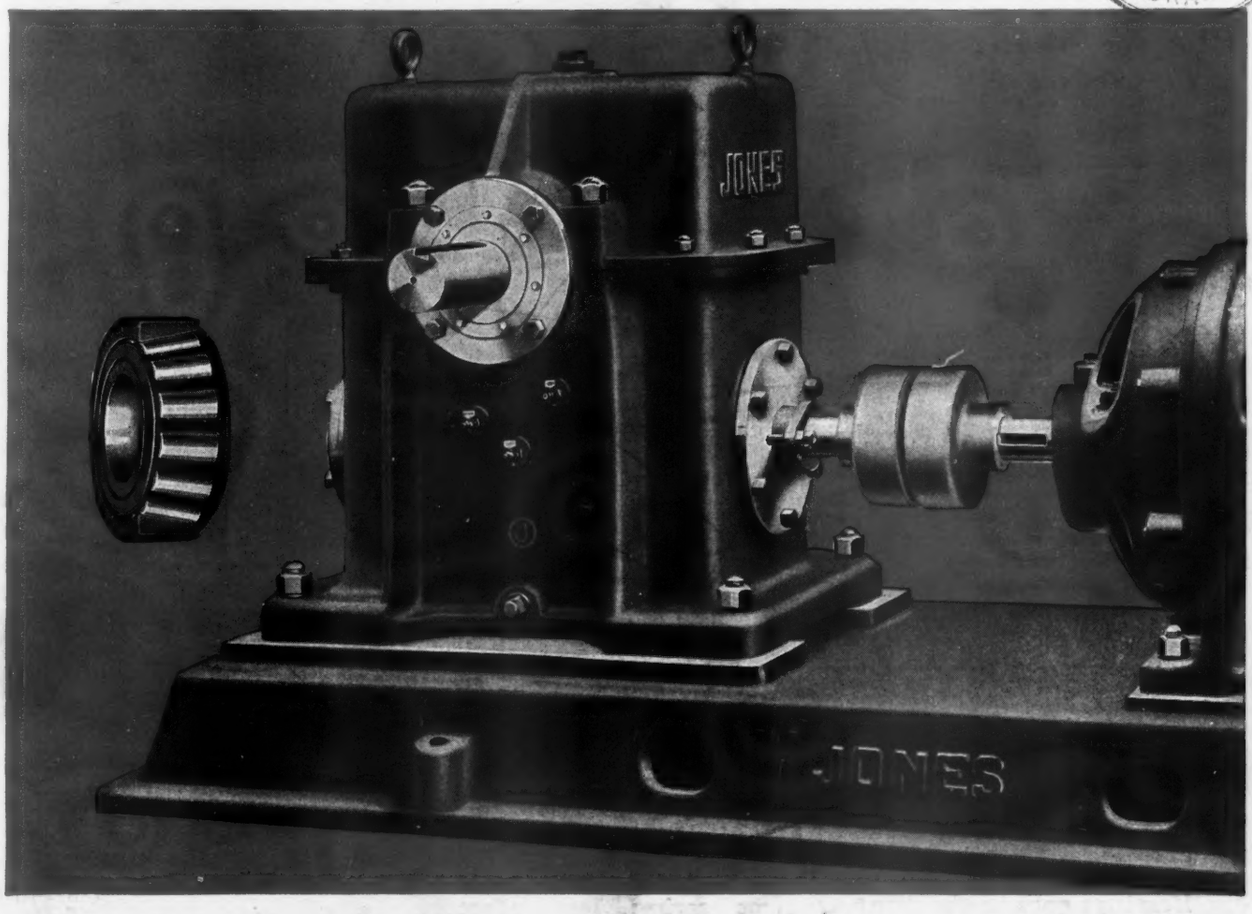


Convincing Tests by Jones and all Industry

Three years of testing preceded adoption of Timken Bearings by W. A. Jones Foundry & Machine Co. of Chicago. "Tests both in our own factory and in actual service have convinced us," writes Mr. Warren G. Jones, President and General Manager, regarding Jones worm gear reducers.

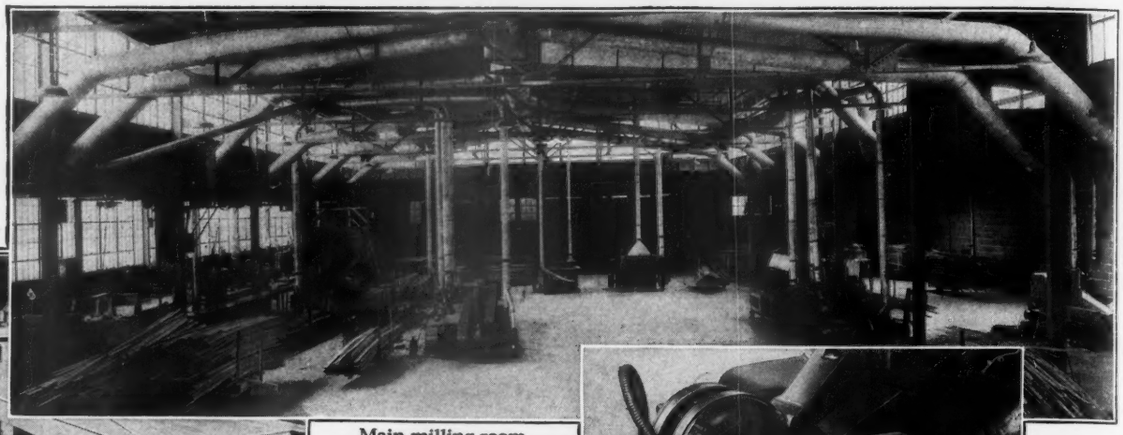
Worm and worm wheel mountings such as this are just "*made*" for Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS*, and Timken electric steel. The indispensable radial-thrust capacity is there, together with greatly reduced friction to insure against needless loss.

These rigid, simple, compact Timken mountings preserve alignment and a high rate of production. The tests of all Industry confirm it.

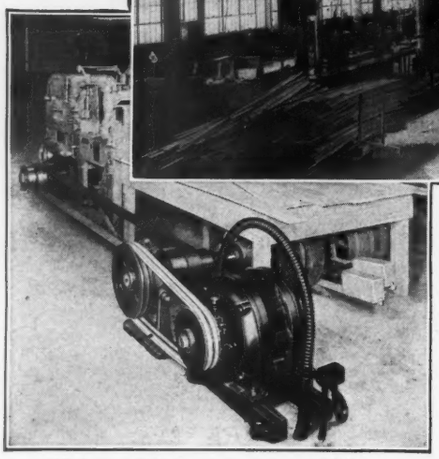
THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

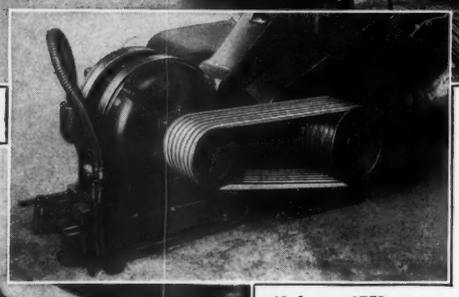
ALLIS-CHALMERS MOTORS



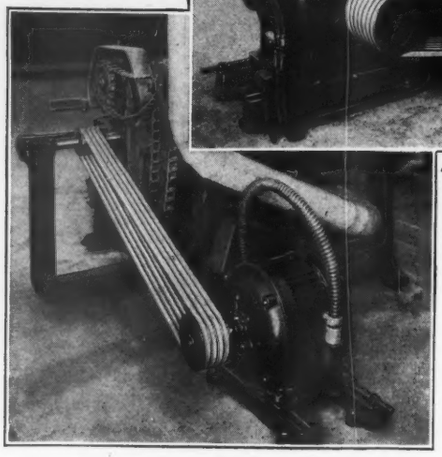
Main milling room, The Cromar Company



15 h.p., 1750 r.p.m., type "AR" roller bearing motor driving Yates moulder through Texrope drive.



40 h.p., 1750 r.p.m., type "AR" roller bearing motor driving Yates miller through Texrope drive



15 h.p., 1750 r.p.m., type "AR" roller bearing motor driving gang rip saw through Texrope drive

One of Industry's most modern electrifications goes into Service with Allis-Chalmers type "AR" Motors and Texrope Drives as Standard Equipment — Plant of The Cromar Company, Williamsport, Pa., Manufacturers of "Cromar" Factory Finished Oak Flooring.

In the Home of "Cromar" Flooring

IT is typical that in this fine plant, which stands as a model of the best engineering practices, Allis-Chalmers type "AR" motors should be used everywhere as standard equipment. Here motor reliability and economy are of first importance and here the sturdy, steel-frame type "AR" motor with Roller Bearings goes to the front. Perfect bearing enclosure is obtained; oil soaked windings are unknown; steady, free, dependable power always available, and this highly economical, interruptionless service may be expected permanently.

In this factory direct-connection of large, slow speed motors is eliminated everywhere by the use of the Allis-Chalmers Texrope Drive. Positive, smooth and noiseless, this latest contribution of Allis-Chalmers to power transmission effects large economies in space and foundation costs and permits the use of higher speed motors with better power factor and efficiency characteristics.

This complete electrification was designed and furnished by an organization whose engineers will assist you in the design and selection of power equipment to best meet your particular requirements. Consult any Allis-Chalmers District Office.

ALLIS-CHALMERS MFG. COMPANY, MILWAUKEE, WIS.

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and TEXROPE DRIVES

INDUSTRIAL ENGINEERING

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Volume 86 — MELVIN O. LOGANSGARD, *Business Manager* — *Number 12*

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HOW about your plant power factor? If you have not checked this up carefully, low power factor may be costing more than you realize. Read the article on page 602 for some real information on how to detect and treat that undesirable condition.

MODELS find an important place in every plant department where excellence of human effort is desired. To prove that this importance is not confined to the fine arts, read on page 617 how R. F. Kneeland directed human effort with a cable layout model to obtain the excellence sought.

USUALLY, losses due to wrong selection of materials handling equipment remain among the so-called "hidden losses." E. J. Tournier on page 614 cites cases with tractor trailer trains that may enable you to turn loss into profit.

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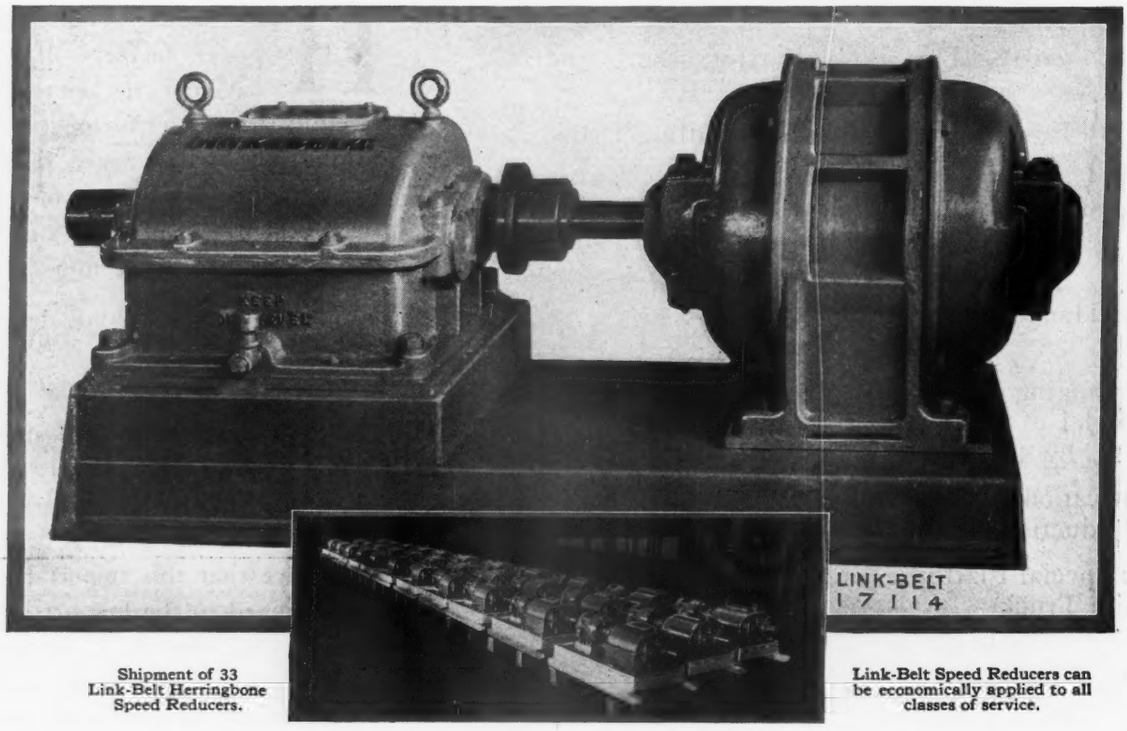
SUBSCRIPTION PRICES: United States and Its Possessions, Canada, Mexico and other countries taking domestic postage rates, $2 a year. All other foreign countries $3 a year. Single copy 25 cents. Published monthly. Entered as second class matter June 7, 1926, at the Post Office, New York, N. Y., under the act of March 3, 1879. Copyright, 1928, by McGraw-Hill Publishing Company, Inc. Printed in U.S.A. Member—A.B.C. Member—A.B.P. CHANGE OF ADDRESS—Subscribers are requested to send both the old and the new address when they move to a new address.

LINK-BELT Herringbone Speed Reducer

(Sykes tooth form)



Shipment of 33 Link-Belt Herringbone Speed Reducers.

Link-Belt Speed Reducers can be economically applied to all classes of service.

LINK-BELT was first to standardize on the combination of continuous tooth Herringbone gears with Timken tapered roller bearings in speed reducer construction.

Herringbone gears generated on Sykes machines are of true involute form and their high efficiencies are maintained indefinitely. Link-Belt Herringbone Speed Reducer parts are made interchangeable by accurate machine work through the use of jigs.

Timken tapered roller bearings maintain accurate shaft centers, eliminate end thrust from the gear teeth, and simplify the lubrication problem.

There is no better, nor more efficient and economical reducer made. To learn more about its construction send for Book No. 815.

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Leading Manufacturers of Elevating, Conveying, and Power Transmission Chains and Machinery

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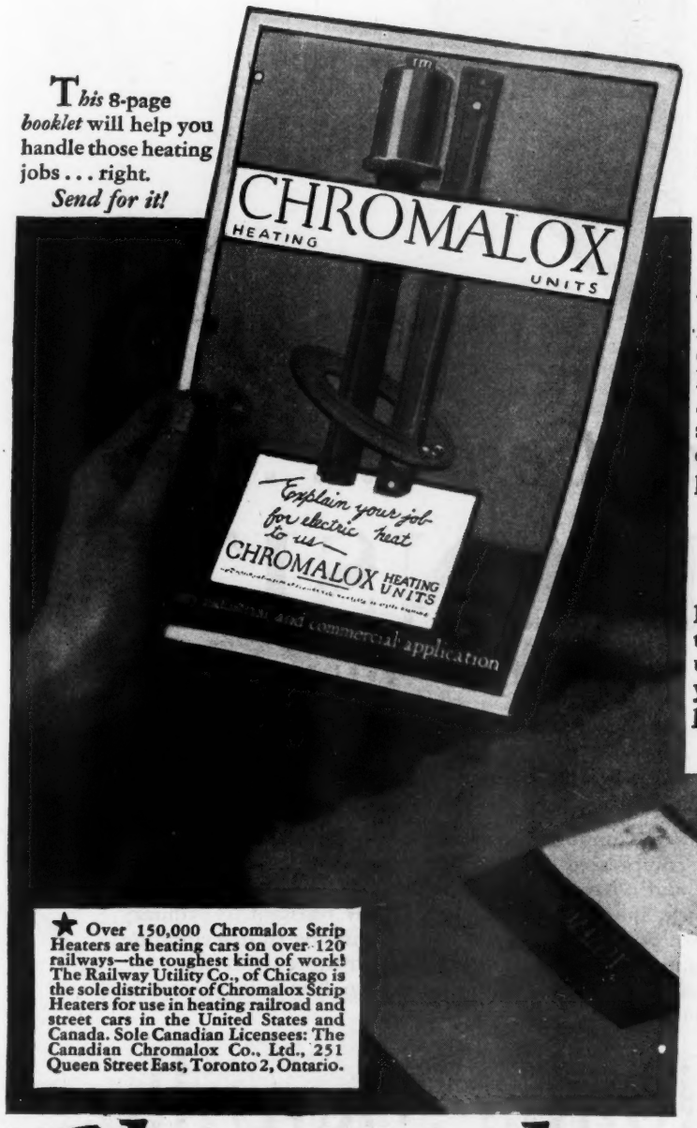
LINK-BELT

★ WRITE FOR YOUR COPY

..*lick those* cold weather *Heating Jobs*



This 8-page *booklet* will help you handle those heating jobs . . . right. *Send for it!*

You too, can save time and money—just as hundreds of companies are doing—by switching over to electric heat and putting Chromalox units to work on those heating jobs there in your plant. With electric heat you can do them quicker and better—without fire risks. And you can easily and accurately control the amount of heat you want.

For BIG Heating Jobs or Small Ones

Whether yours is a big job or a small one . . . . heating anything from tanks of fluids to compounds . . . . or melting anything from grease to metal . . . . or keeping pipe lines and equipment from freezing up . . . . or heating buildings varying from a watchman's shanty to a sizable warehouse or substation—the chances are that you can use stock heating units pictured and priced in this bulletin.

We Will Help You
put an end to your heating troubles

Before freezing weather starts giving you a lot of trouble, mail the coupon for your copy. And tell us all about what you want to heat so we can give you a quick and definite answer to your heating problems. There's no obligation.

★ Over 150,000 Chromalox Strip Heaters are heating cars on over 120 railways—the toughest kind of work! The Railway Utility Co., of Chicago is the sole distributor of Chromalox Strip Heaters for use in heating railroad and street cars in the United States and Canada. Sole Canadian Licensees: The Canadian Chromalox Co., Ltd., 251 Queen Street East, Toronto 2, Ontario.

. . . mail with your letterhead! I.E.-12-28

Edwin L. Wiegand Co., 422 First Ave., Pittsburgh, Pa.

YES, without obligation, send me a copy of this Chromalox bulletin and any other data that will help me determine what heating units should be used for

heating a _____

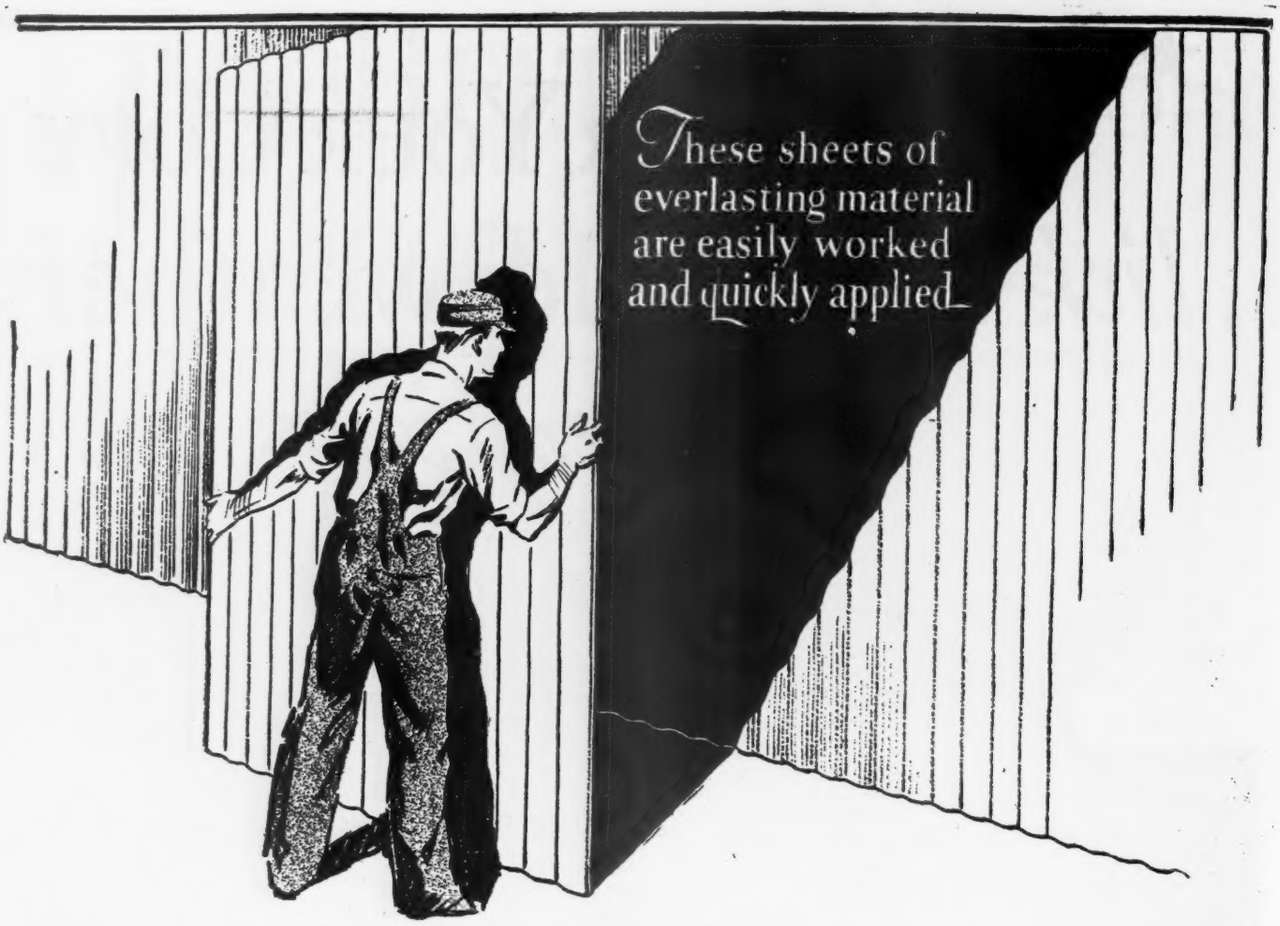
_____

_____

Signed _____ *Position* _____

(PLEASE WRITE PLAINLY)

Chromalox
ELECTRIC HEATING UNITS

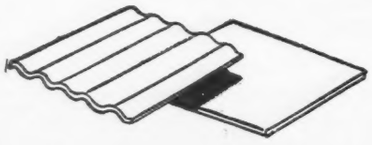


First Cost is Last Cost . . . .

When You Build with

TRANSITE

Asbestos Lumber



Buildings constructed with walls and roofs of Johns-Manville Transite offer you permanence of construction and a maintenance cost so low as to be practically negligible. No other type of material equals it from the point of view of economy.

Transite is composed solely of asbestos fibre and Portland Cement, compressed into uniform monolithic sheets, easily handled and virtually indestructible. It will not rot, rust, warp, crack, split or corrode. It is highly resistant to ordinary gases. Not only is it fireproof and so immune to deterioration that it actually toughens and grows stronger with age, but Transite is unsurpassed for resistance to fumes incidental to various industrial processes.

Transite is finished in two types—corrugated and flat. Sheets are 42 inches wide, materially cutting down side laps. This greatly lowers the chance of infiltration of the elements and air leakage as compared with sheets of narrower width. Transite is easy to handle and apply. No special tools are needed.

* * * *

For full details of its application possibilities, kindly address: Transite Asbestos Lumber Section, Johns-Manville Corporation, 292 Madison Avenue, New York City

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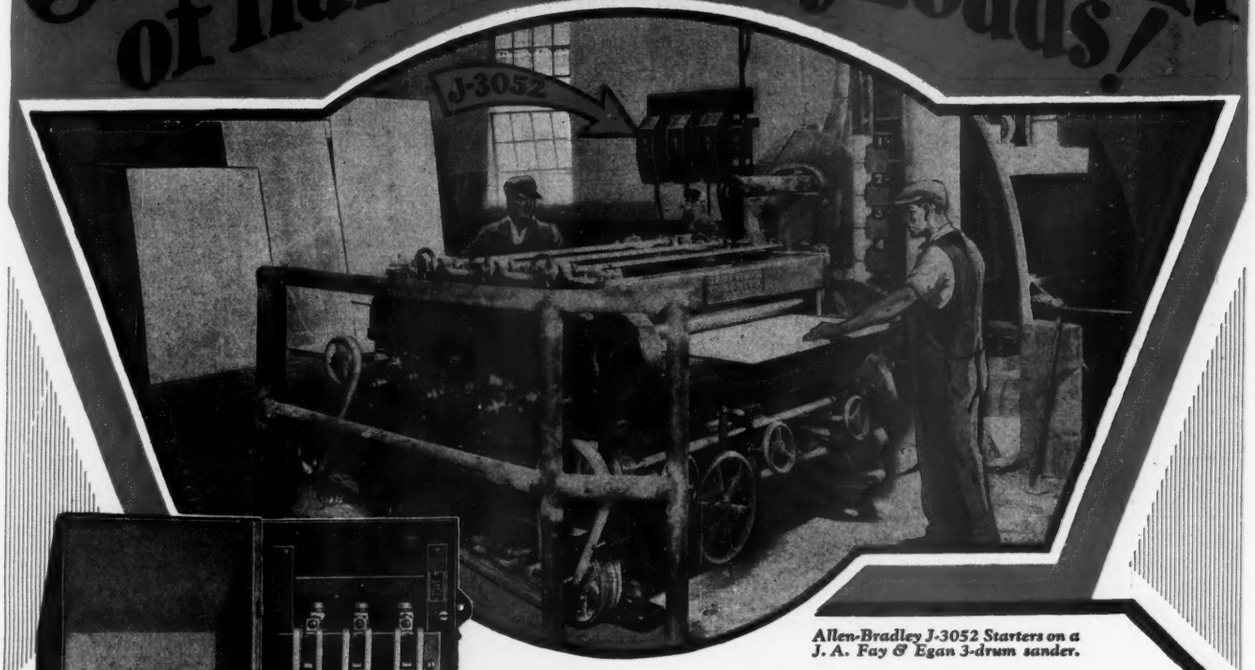
Johns-Manville

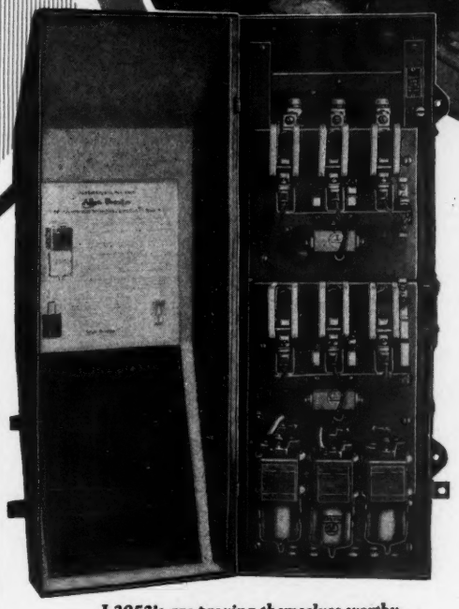
Transite

Asbestos Lumber

Smooth Acceleration of Hard Starting Loads!



Allen-Bradley J-3052 Starters on a J. A. Fay & Egan 3-drum sander.



J-3052's are proving themselves worthy of the hard jobs; they are also best for ordinary jobs. Let us tell you why.

Allen-Bradley J-3052 Automatic Resistance Starters are creating new standards in the correct way of starting squirrel-cage motors, because:

1. **They provide velvet smooth acceleration—possible only through use of graphite compression resistors.**
2. **They prevent second current inrush and second jolt—the line contactor short circuits the resistance before the starter contactor opens.**
3. **Graphite compression resistors are easily and quickly adjusted to fit motor load; a single nut adjusts all resistance and there are no taps to change.**
4. **J-3052's cost no more in spite of their many superior features.**

It will pay you to investigate the smooth starting qualities of the J-3052.

A-B

Allen-Bradley Starters

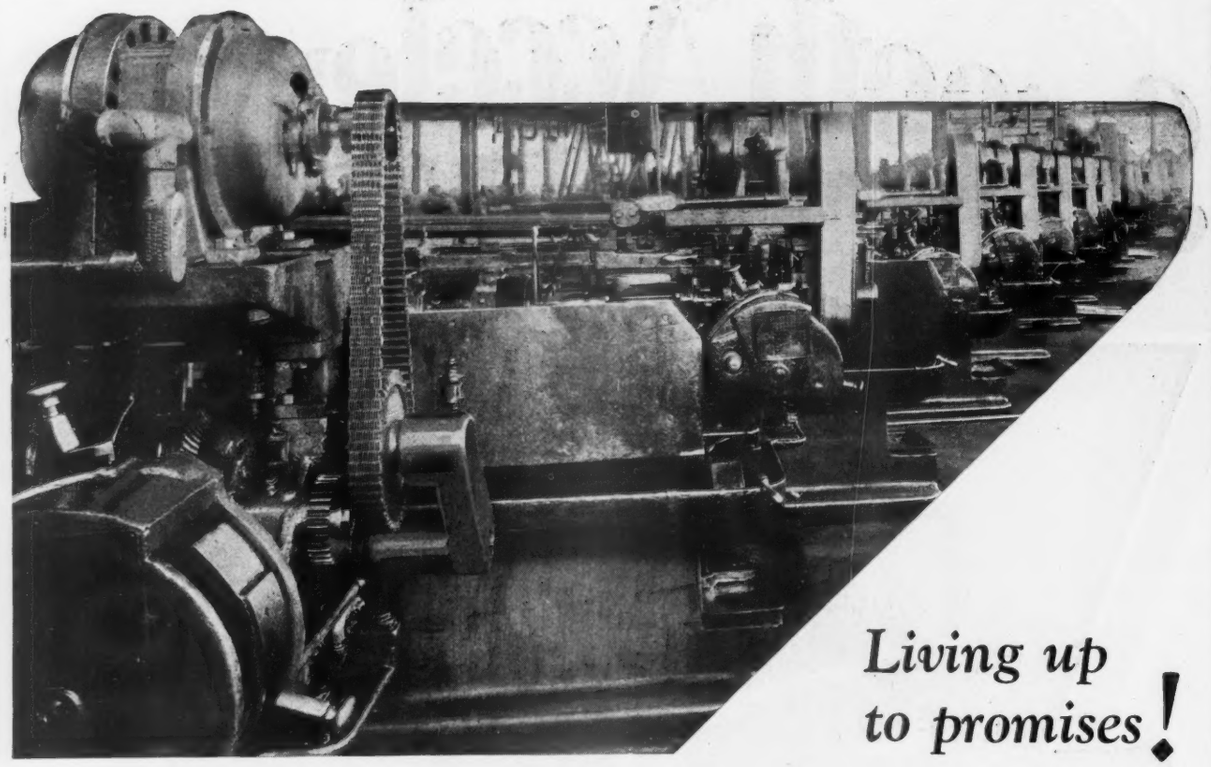
MAIL THIS COUPON

Allen-Bradley Co.,
491 Clinton St., Milwaukee, Wis.

Of course we want to know about smoother starting for squirrel-cage motors provided by J-3052's. Send your catalog.

Name_____

Address_____



Living up to promises!

SEVERAL years ago The Marquette Metal Products Company of Cleveland started in to modernize their power transmission. Overhead line-shafting was replaced with individual motor drives with "WHITNEY" SILENT CHAINS as shown in above view of a battery of automatic screw machines.

Justification of this course is best summed up in the words of Mr. Herbert Gleitz, Vice President and General Manager.

"Individual drives have saved us in power costs approximately 22% and increased our production 8% in eliminating slippage."

Let us assist in solving your power transmission problems. Whether it be for standard equipment or for revamping old drives there are "WHITNEY" Chains for your drives.

Call or Write Our Nearest Office

THE WHITNEY MFG. CO., Hartford, Conn.

SALES AND ENGINEERING OFFICES

NEW YORK	BOSTON	PHILADELPHIA	SYRACUSE	CHICAGO
L. C. Biglow & Co., Inc. 250 W. 54th St.	The Whitney Mfg. Co. 711 Boylston St.	The Whitney Mfg. Co. 133 So. 36th St. Philadelphia Gear Works Erie Ave. and G St.	George McPherson 201 Norwood Ave.	The Whitney Mfg. Co. 549 W. Washington Blvd.

PITTSBURGH	CLEVELAND	DETROIT	SAN FRANCISCO	SEATTLE
Pittsburgh Gear & Mach. Co. 27th & Smallman Sts.	Smith Power Transmission Co. 1213 W. Third St.	The Whitney Mfg. Co. 2-240 General Motors Bldg.	A. H. Coates Co. 615 Howard St.	A. H. Coates Co. 1743 First Ave., So.

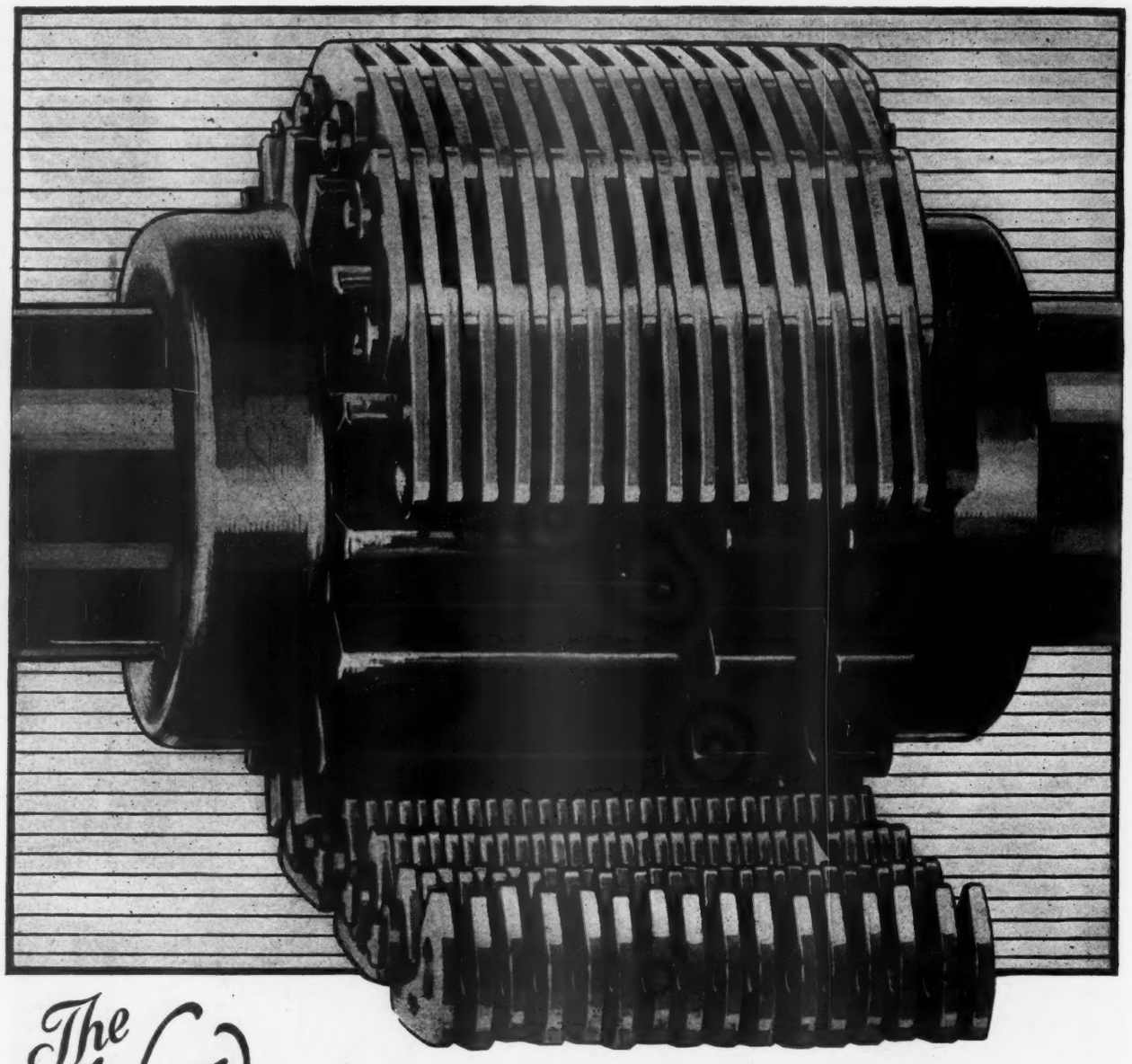
PORTLAND, ORE.	LOS ANGELES
Portland Iron Works 495 Northrup St.	L. A. Automotive Works 1020 Towne Ave.

CHAINS AND SPROCKETS FOR POWER TRANSMISSION

Give Red Bands your hard jobs

A complete line of squirrel cage single phase motors without commutators or brushes; and also polyphase motors from ½ to 100 H.P. Sold, serviced and carried in stock in all the principal cities.

HOWELL ELECTRIC MOTORS COMPANY
HOWELL ◆ MICHIGAN



The New MORSE Flexible Coupling

SIMPLICITY is the keynote in the design of this new Morse Flexible Coupling. It consists merely of a Morse Silent Chain encircling two sprockets as shown. The guide groove in one sprocket holds chain in place, while the other sprocket is free to float under the chain. The chain fits loosely enough on the sprocket to take care of ordinary misalignment.

Simple design combined with the high efficiency and long life for which Morse Chains are noted, provides a coupling ideal for most requirements. Fill in the coupon for complete data.

See the Morse Flexible Coupling Exhibit in Booths 264 and one-half of 263 at the Seventh National Exhibition of Power and Mechanical Engineering, Grand Central Palace, New York, Dec. 3d to 8th.

MORSE CHAIN CO., ITHACA, N. Y.

Branches in Principal Cities

Manufacturers of the

Original Morse Rocker Joint Chain, the most widely used silent chain in the world.

3003

Morse
Chain Co.,
Ithaca, N. Y.

Please send complete data on the new Morse Flexible Coupling to:

Name.....

Position.....

Company.....

Address.....

City and State.....

I.E.

Certified by BENJAMIN

This Label and This Book

—a guide to the two essentials of an effective system of lighting—good equipment and correct planning of the lighting installation.

The Label is a mark of quality. It is a symbol of success in design and construction. It identifies

BENJAMIN
Certified Lighting Equipment

your one means of securing reflectors and other lighting units that will give you the fullest benefits from your lighting system over a lifetime of service.

The Book gives specifications for an effective lighting system; tables of correct intensity of light for industrial interiors; reflector spacings and lamp sizes; the reflector or unit to use for various conditions or plant operations; a simple method of gauging the effectiveness of your lighting—all the facts a plant executive should know.

BUY BY THE LABEL AND GO BY THE BOOK

FREE TO YOU—
This Book is Yours for the Asking—
Send for it Today

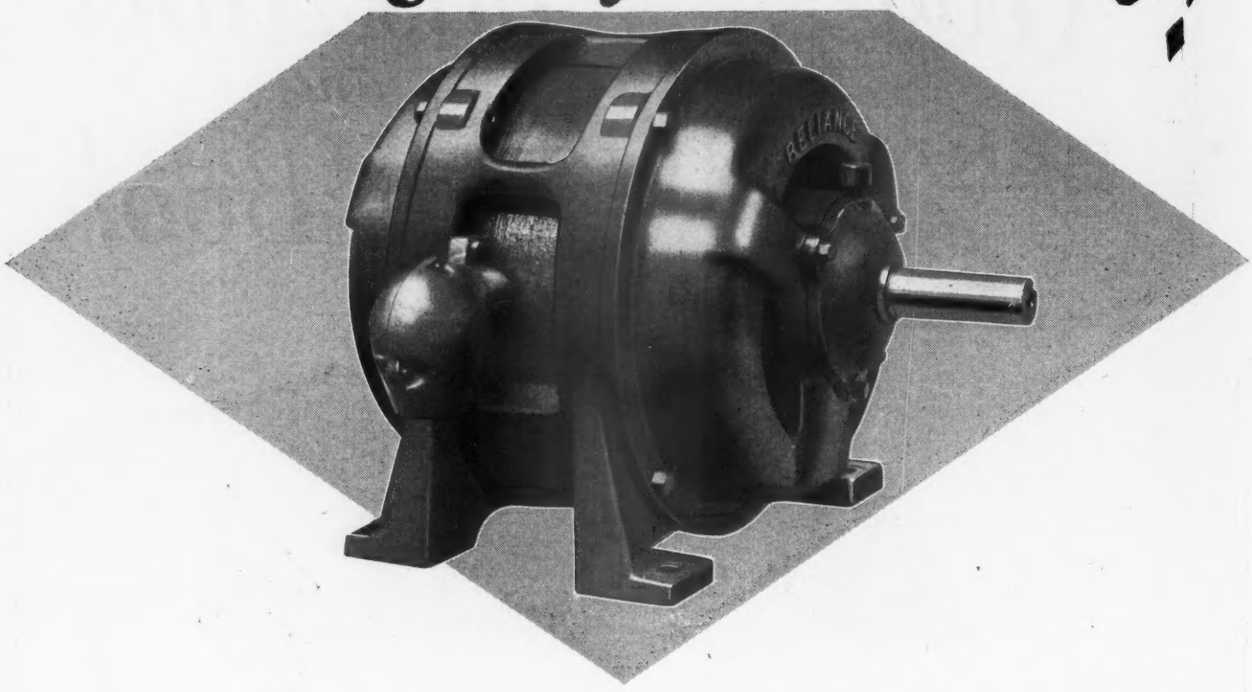
Benjamin Electric Mfg. Co.

120-128 So. Sangamon Street

New York **Chicago, Ill.** **San Francisco**

© 1928

More *for your money!*



Note these savings

The following table shows the percentage savings which you make when buying Type AL Reliance Motors with automatic pushbutton control as compared with the ordinary squirrel-cage motor with hand-operated starting compensator. Figures are for 3-phase, 60-cycle, 220-volt equipment:

Hp.	1800 r.p.m.	1200 r.p.m.
7½	28%	23%
10	24%	20%
15	21%	17%
20	13%	10%
25	11%	8%

The savings in dollars vary from $23 to $41.

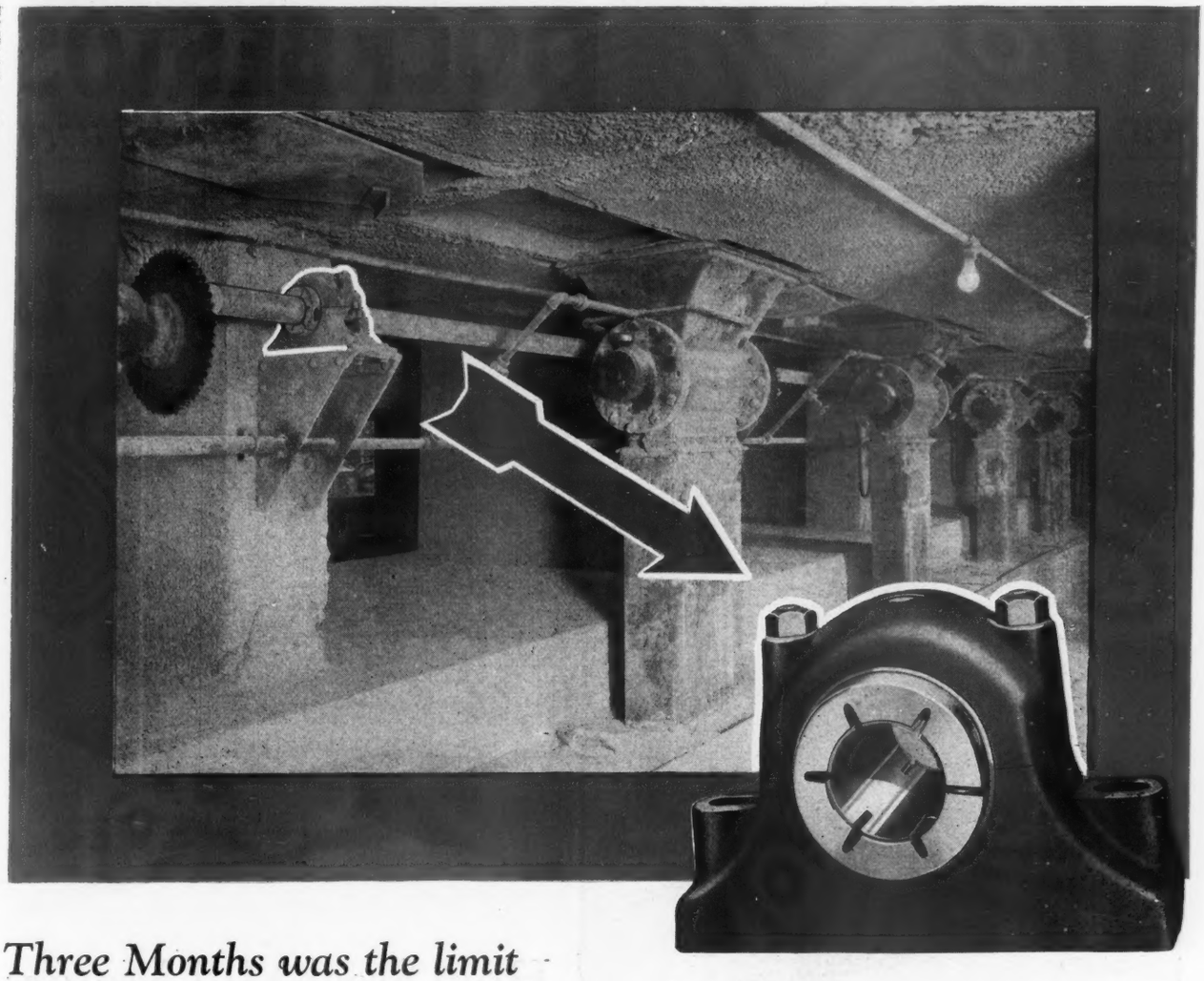
THIS new Reliance Across-the-Line Motor makes it possible for you to get more for your money when buying 7½ to 30 hp. induction motors.

For less than you are paying for the ordinary motor and starting compensator you can now have Type AL Motors and pushbutton control. This new combination is also a money saver after it is on the job. It saves time by making starting easy and convenient. It saves on upkeep because the starters require less attention and fewer replacements.

Our Bulletin No. 1093 gives all the details.

RELIANCE ELECTRIC & ENGINEERING CO.
1051 Ivanhoe Rd. Cleveland, Ohio
Branches: Boston, New York, Buffalo, Pittsburgh, Philadelphia, Birmingham, Cincinnati, Detroit, Chicago, St. Louis

RELIANCE A-C D-C MOTORS
with Ball Bearings



Three Months was the limit before they installed Dodge-Timkens

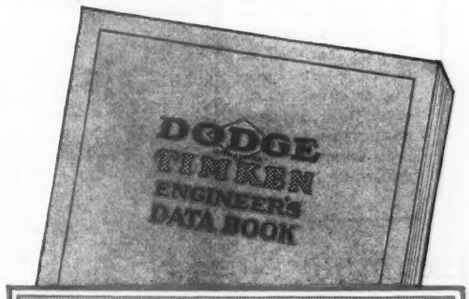
This Dodge-Timken Pillow Block has been on the job two and a half years in a cement mill. Oiling every thirty days is all the attention it has had.

Prior to its installation, babbitted bearings on the same job lasted three months, then a shutdown for re-babbitting and shifting scored shafts was necessary.

You can depend upon triple sealed Dodge-Timkens anywhere. Where abrasive dust spells ruin to most bearings, Dodge-Timkens will eliminate trouble and cut maintenance costs.

DODGE MANUFACTURING CORPORATION, Mishawaka, Ind.
Factories at MISHAWAKA, Ind., and ONEIDA, N. Y.

DODGE
MISHAWAKA
TIMKEN



Please send me the Dodge-Timken Engineer's Data Book.

*Name*_____

*Position*_____

*Firm*_____

*Address*_____

There's a Dodge-Timken for Every Industrial Need

WHY WHEN and WHERE TO USE **ROCKBESTOS** —*the asbestos covered wire*

Coils being made of Rockbestos Magnet Wire in the winding room of Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.

Latest type steel mill motor (Form "W") of Crocker-Wheeler Electric Mfg. Co. Its coils are made of Rockbestos Magnet Wire.

Rockbestos should be used for furnaces, ovens, switchboards, controllers, boiler room lighting circuits, motor leads and internal connections — in fact, wherever wire encounters heat.

Example No. 14

How Steel Mill Motors Are Protected Against Temperature Rise

Steel mill motor coils are subjected to intense heat. Temperature rise of motor and severe operating conditions forbid the use of ordinary insulation. It would char or deteriorate with serious consequences.

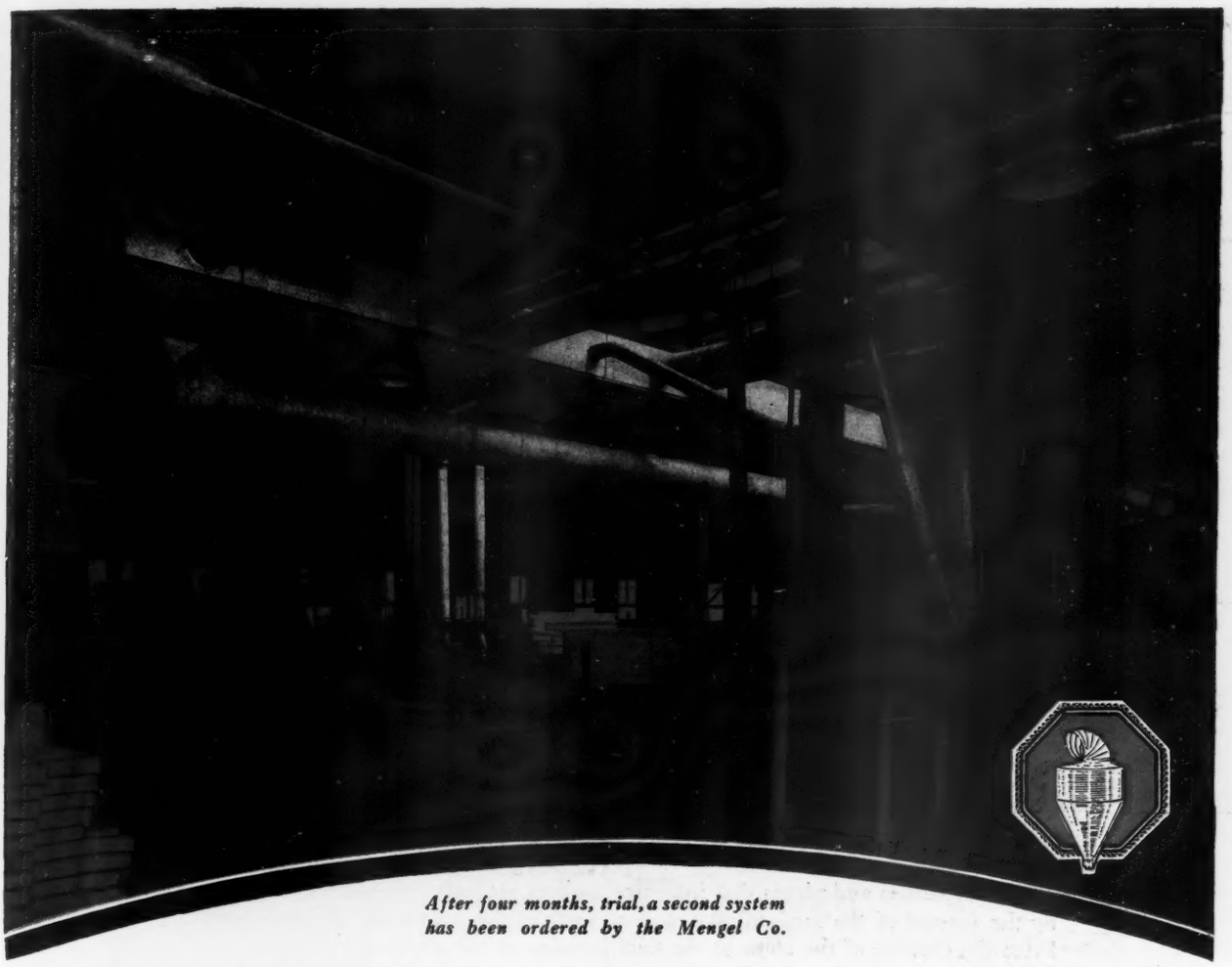
Foremost manufacturers of steel mill motors have recognized the superior protective qualities of Rockbestos —the asbestos insulated magnet wire. They wind their coils with it as an assurance of satisfactory performance.

ROCKBESTOS PRODUCTS CORPORATION

NEW HAVEN, CONN.

5942 Grand Central Term. Bldg., New York — 465 Union Trust Bldg., Pittsburgh, Pa. — 224 Madison Term. Bldg., Chicago

C. Dent Slaughter—On the Pacific Coast.



After four months, trial, a second system has been ordered by the Mengel Co.

New Design of blower system makes layout changes easy

It was after several years of experimenting that Kirk & Blum made this first installation of the K. & B. Chainless, Air-Tight Plenum Main System for Dust and Shavings Collecting. Now after four months thorough, trial, the user, The Mengel Company of Louisville, Kentucky, has ordered a second installation.

This system, we believe, solves a problem that faces every large production woodworking plant where location of machines must be changed at times to facilitate proper sequence of operations in mass production.

With this new K. & B. system not only can changes in the layout be made at a fraction of former costs, but due to its design, much higher efficiency is assured. *Mechanical conveyors*, such as are sometimes used in similar equipment, are *eliminated* from this K. & B. system. There are *no air openings* in plenum main. Thus no heat from building is wastefully removed, and power at the fan is saved.

Like the K. & B. tapered main system, this new plenum main system is installed with a definite guarantee of maximum power and minimum suction.

A complete system is set up here at The Kirk & Blum Mfg. Co. plant for demonstration at your convenience. We suggest you see this system in operation, or write for further details.

THE KIRK & BLUM MFG. CO., Cincinnati, Ohio

Detroit Factory and Office, 4718 Burlingame

Pittsburgh Representative:
THE BUSHNELL MCHY. CO.
700 Century Bldg.

Louisville Representative:
LIBERTY BLOWPIPE CO., Inc.
917 S. 12th St.

Canadian Representative:
CANADIAN-ROGERS, LTD.
Winnipeg and Toronto

KIRK & BLUM
Plenum Systems

chainless . . . air-tight

(Patent Pending)

FORESTS TO PRINT SHOP

The personalities and places that influence authors are only approached in interest by the control of the mechanical processes used in the production of their books. From the cooking of the chips to the final pressing of the glued-on cover, temperatures and pressures play definite and most important parts in the making of a book.

And, for each of these jobs—pulping, paper-making, ink-making, the printing operation itself, especially when color work is being handled, embossing and binding—the control of temperatures, pressures, and humidities are modern production necessities.

As the scientific methods used in these industries developed, both the paper manufacturers and printers found that the *Tycos* research organization had anticipated their needs. *Tycos* had developed a line of accurate indicating, recording, and control instruments which are included today among the 8,000 styles of *Tycos* Instruments—standards of accuracy in every industry.

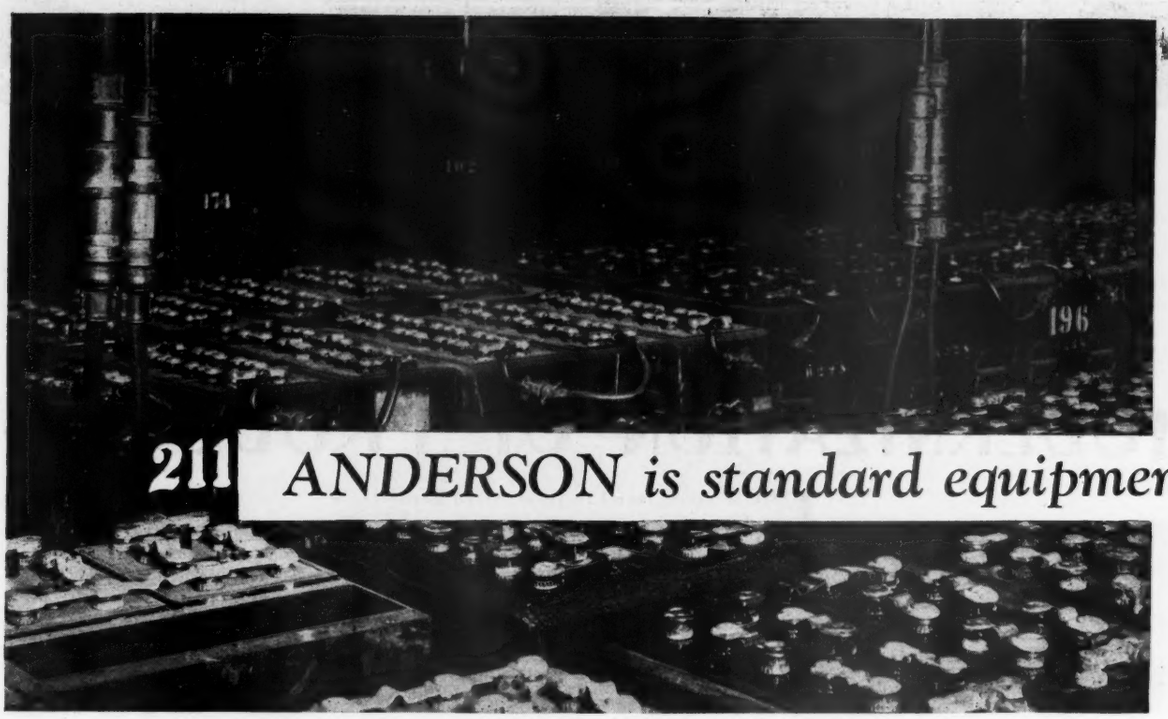
Taylor Instrument Companies
Rochester, N. Y., U. S. A.
CANADIAN PLANT, *TYCOS* BUILDING, TORONTO
Manufacturing Distributors in Great Britain:
Short & Mason, Ltd., London.

Tycos

Temperature Instruments

INDICATING—RECORDING—CONTROLLING

Tycos THE SIXTH SENSE OF INDUSTRY



211 *ANDERSON is standard equipment*

—almost everywhere— American Railway Express no exception—

On railways—buses—on industrial trucks—in the steel mills —everywhere that heavy duty plugs and receptacles are in use, you will find Anderson equipment. The American Railway Express with its charging stations from Coast to Coast is no exception. Here in the New York City plant is shown row upon row of storage batteries being charged by means of Anderson plugs and receptacles. Also on the trucks and on the side walk charging stations, Anderson plugs and receptacles are standard equipment.

Our engineers will be glad to cooperate with you in the design and construction of heavy duty plugs and receptacles to exactly meet your requirements.

Send for the 72-page illustrated Bulletin No. 38.

Albert & J. M. Anderson Mfg. Co.
289-305 A St., Boston, Mass.
New York Chicago Philadelphia London

Some
ANDERSON PRODUCTS:

1. **Automatic Time Switches.** The Anderson Time Switch is designed to give the type of time control service which you will demand of a dependable instrument. Absolute dependability on time control year in and year out. Used for various purposes in industrial plants wherever it is desired to automatically open and close an electrical circuit at predetermined times.
2. **Heavy Duty Plugs and Receptacles.** In this line especially, operating men are finding new applications daily where Anderson equipment is indispensable. Talk to us about any special requirement.
3. **Heavy Knife Switches.**
4. **Circuit Breakers.**
5. **Heavy Copper Work.** We are equipped for machining and forging heavy copper work for all purposes and are prepared to furnish copper castings of any shape or size having an exceptionally high degree of electrical conductivity.
3. **Alligator Jaw Testing Clamp.** Designed especially for making temporary electrical connections.
7. **Overhead Line Material.** Aetna Insulation.
8. **Bus Bar Benders.**
9. **Bus Bar Clamps.**

WHAT THE REEVES MEANS TO THE MODERNIZATION OF PRODUCTION

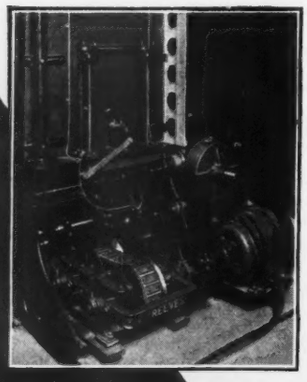
THE modern trend in production is merely a wide-spread movement toward greater efficiency. Mass production, elimination of waste effort, accurate machinery in place of hand labor . . . all these are steps toward the goal. And as the amount of machinery grows, and the number of machine processes increases, the need for controlling the speed of machinery becomes more apparent.

Single-speed machinery is out of the question. Step-adjustments are insufficient. Modern machinery must be *infinitely* adjustable in speed . . . must be capable of hairline speed changes . . . able to take advantage of every production change and to meet each variance in operating conditions with a like variance in operating speeds.

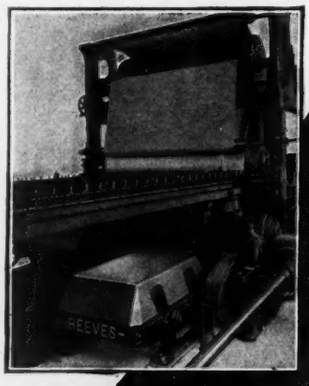
The REEVES Transmission represents the *only* method which gives *infinite* speed adjustability. It does not give just *steps* in speed . . . but *any* speed between fastest and slowest, even to the smallest fraction of a revolution. Simple, compact, inexpensive and easy to install. More than 40,000 REEVES Transmissions are now in operation, and more than 400 machinery manufacturers incorporate the REEVES as a standard part of the machines they build.

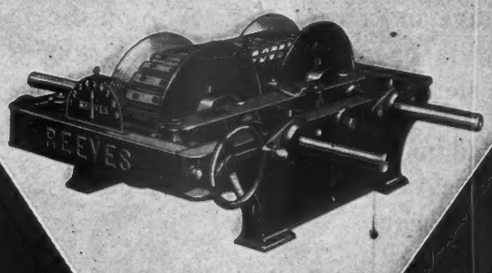
Fill in the coupon below and mail it today for the new REEVES Catalog, E-88, which gives more detailed information on REEVES advantages in specific industries.

Two REEVES Transmissions at the central control board which regulates the time cycle of the traffic lights in Chicago's loop district. Through these REEVES units the time cycle can be adjusted instantly *in exact accordance* with the traffic condition of the day and the hour.



The REEVES Transmission as standard equipment on the new Palmer Tenter Finishing Machine Manufactured by the Morrison Machine Company of Paterson, N. J. Through the REEVES the speed of this machine can be adjusted to suit *exactly* the weight of fabric being processed.





REEVES PULLEY CO., Columbus, Indiana

☐ Please send me your new catalog No. 88.

☐ Send me information on the uses of the REEVES in the _____ industry.

Name _____

Address _____

THE NEW REEVES Variable Speed Transmission

E

MODERN MACHINERY MUST BE ADJUSTABLE IN SPEED

Buss Fuses and Precision Instruments

The Taylor Instrument Companies, Rochester, N. Y., manufacture the well-known Tycos line of instruments for indicating, recording and controlling temperature and pressure.

Their manufacturing experience befits them for judging precision and dependability in other products.

Taylor's selection of Buss Renewable Fuses for the electrical protection of their plant and equipment is another outstanding recognition of Buss merit.

If you, too, wish to know about the true merits of Buss Renewable Fuses, send for free sample.

BUSSMANN MANUFACTURING CO. · · ST. LOUIS, MO.

A Tycos recording thermometer, one of the many precision instruments manufactured by the Taylor Instrument Companies.

BUSS FUSES

Get rid of this Thief of Power—*with*

Philadelphia
SPEED REDUCING UNITS

Remember—no mere assemblage of gears in a housing is an effective, economical speed reduction unit. It may absorb so much of the prime-mover power that you lose thousands of dollars annually in a big plant having many units. Philadelphia Spur Gear and Worm Gear and other Speed Reducing Units are EACH an expert engineering job. Spur Gears are Chrome Nickel Steel, heat treated, accurately machined. Worm gears are chill cast bronze, with accurately generated cut teeth. Roller bearings on high speed elements. "Ring-Oiling" Bronze Bushings—on slow speed shafts. Splash bath system lubrication. An exclusive feature is the oil filter screen at each end of the Philadelphia integral worm and shaft.

Space forbids more details. But you can depend upon 50 years of gear making experience to insure satisfaction in Philadelphia Speed Reducing Units. **ALL SIZES—ALL TYPES**—for all ratios, hp. up to 200. Ideal for use with low cost, high speed motors. Write for details.

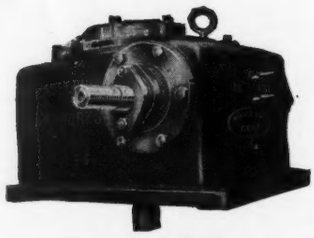
Main Office and Plant Erie Ave. and G St. Phila., Pa.

PHILADELPHIA GEAR WORKS

Manufacturers of Industrial Gears and Speed Reducing Units

PHILADELPHIA, PENNA.

Branch Sales and Engineering Office: 12 E. 41st St., New York



Worm Gear Reducer Type V.X.

PHILLIE GEAR

Power Saving Products

GEARS, Spur, Worm, Herringbone, Internal, Bevel, Miter, Intermittent, Spiral, Helical.

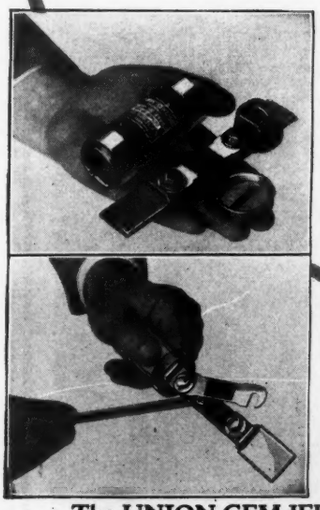
NON-METALLIC PINIONS: Fabroil, Textolite, Rawhide.

Whitney Silent and Roller Chains, Sprockets, Flexible Couplings, Universal Joints, Racks, Ratchets and Pawls, and a complete line of gear driven

SPEED REDUCING UNITS

AGMA

Venting, an important consideration in fuse operation, is secured and maintained by means of carefully proportioned passages in the case. This method provides for the escape of gasses and prevents molten metal from "freezing" the caps.



Fewer number of parts promote speed in renewals. Only one cap is removed. The other remains on the knife blade.

Fusible link of knife-blade type is notched at both ends to permit slipping into or out of place, when studs are only slightly loosened.

The UNION-GEM-JEFFERSON Line is Sold Through Wholesalers

Meeting the Demand for Low-Cost PROTECTION

NEVER before has value played such an important part in the selection of equipment. For example, more and more plants have learned that fuses are not all alike—that Union Renewable Fuses not only give dependable protection to electrical circuits—but stay in service longer—cost *less* because they are *worth more.*

Simplified design and construction keep Union Renewable Fuses as serviceable as new—after repeated blowouts. The extra heavy and tough grey horn fibre case is vented by an exclusive method. Vents are in the fibre shell and are scientifically proportioned to relieve the pressure generated when the fusible element blows. Molten metal is not forced into end cap threads.

In addition to these advantages, which insure a new fuse for the price of a link, the extreme simplicity of design and fewer parts make renewals quick and easy.

In the knife-blade type, both ends of the fusible link are notched—therefore the studs that hold the link need be loosened only slightly when making renewal. In the ferrule type, two nibs on the washers fit into corresponding holes in the body and prevent the link from twisting. Links are bent at one end to make renewal easy.

Our new catalog No. 33 gives complete facts. Send for your copy—also free FUSE CHART which tells at a glance proper size and style of fuses for dependable electrical protection at low cost.

Chicago-Jefferson Fuse & Electric Co.
1511 WEST 15TH STREET
Chicago, Ill.

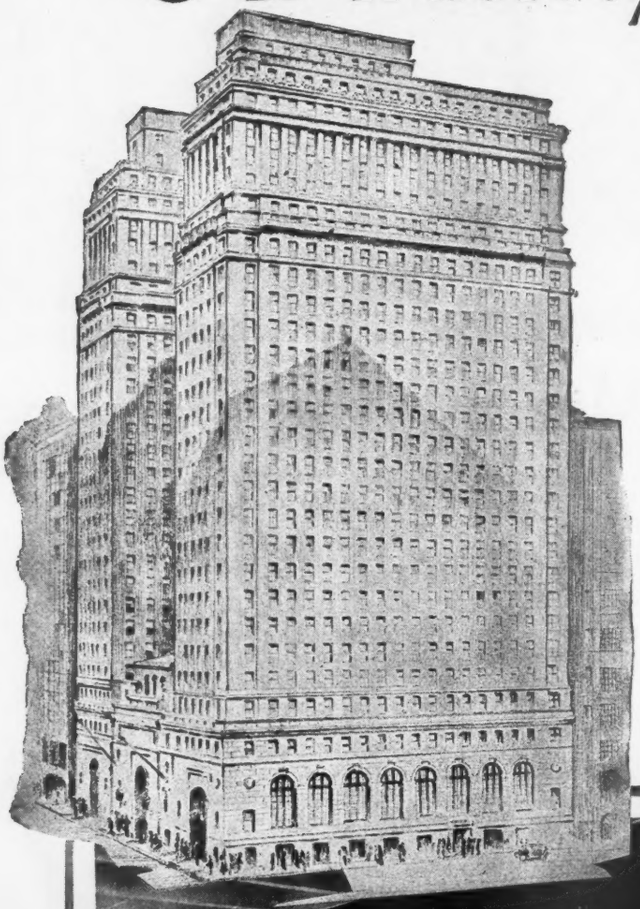
UNION FUSES

Because they are worth more they really cost less

(8070)

In Philadelphia's largest office building

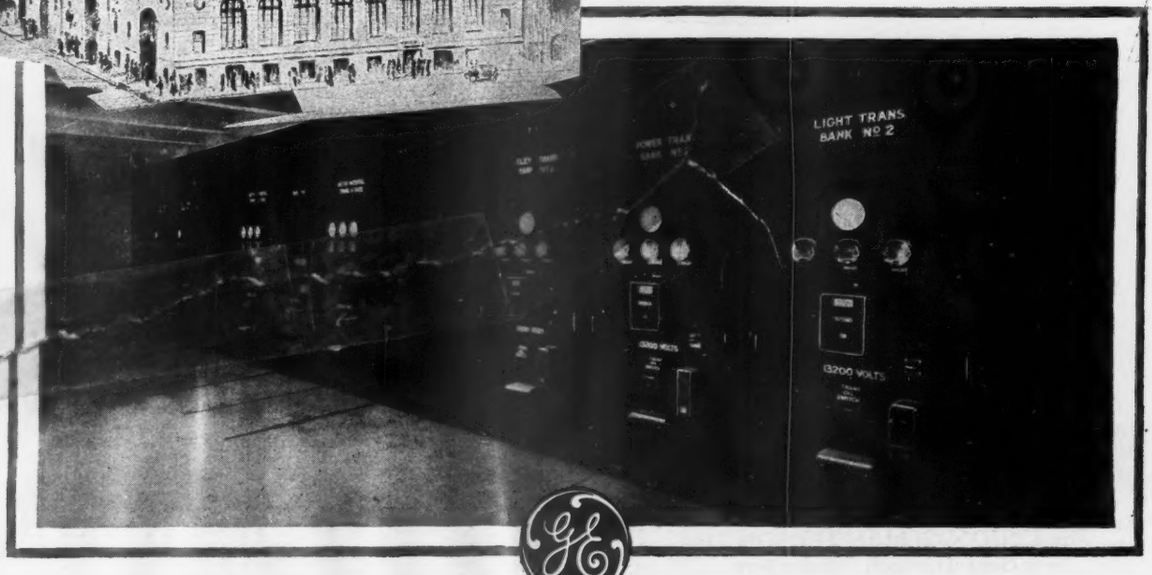
G-E Truck-type switchgear



In the new Fidelity-Philadelphia Trust Company Building, G-E safety-enclosed truck-type switchgear controls the flow of power to lights, elevators, and ventilating system.

This control is effected with the greatest possible safety—because G-E truck-type switchgear is totally enclosed and the live parts are protected. Power interruptions are negligible—because a spare unit can be immediately inserted when it becomes necessary to withdraw a truck for inspection or adjustment. Again, these trucks were inexpensively installed—because they were completely assembled when shipped.

Your present or future building can also have the advantages of G-E truck-type switchgear. Call a G-E switchgear specialist and have him help you with your problem.



461-18

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Who Ever Heard of INSULATING A MOTOR WITH WATER ?

—You have heard of the thousands of motors that go down every year—

FROM WATER

You also know that Lubricating Oils, by carbonizing windings cause 40% of Motor breakdowns—

Do you know that CHINALAK builds a barrier Oil and Moisture cannot penetrate?

Chinalak is protecting thousands of Motors by thoroughly saturating the winding and then Sealing them—

A 3 Mil—build-up per dip—after the first penetrating dip.

Over 1200 Volts per Mil dielectric—

Long life under heat stress—

High Resistance to Acids and Alkalis—

Maximum Dielectric Resistance

Low Dielectric Loss.

Where the unusual qualities of Chinalak have been established.

For the past six years Chinalak has been going into the Steel Mills, Coal Mines, Paper Mills, Dye Houses, Chemical Plants, Bleacheries, Street Railways, etc.

NOW—
the facts are established.

Motor buyers are requesting that the motors they buy be Chinalak treated.

Dolph's Practical Shop Test.

John C. Dolph Co., 168 Emmet St., Newark, N. J.
Please send me a removable head drum (about 60 gallon) at $1.35 a gallon F.O.B. my shop, so that we may thoroughly test Chinalak. I understand I may retain the drum without charge.
($1.60 west of Mississippi River.)

Signed .....

per .....

Address .....

This order is subject to Dolph's broad guarantee that if Black Baking Chinalak does not prove satisfactory, it may be returned and amount charged will be refunded immediately.

Dolph's CHINALAK BLACK BAKING

THE LIQUID LIFE of PROTECTION

JOHN C. DOLPH CO., INSULATION SPECIALISTS, NEWARK, N. J.

TRADE MARK

STEELTUBES

A Brand New Product

will be announced by this company next month.

It marks the most progressive step that has been taken in the electrical industry in many years and . . will go far in reducing the cost of electrical installations. Write direct for advance information.

ELECTRICAL DIVISION

Steel and Tubes, Inc.

CLEVELAND . . . . . OHIO

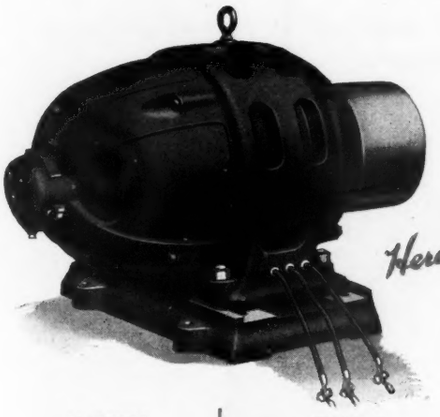
A subsidiary of Republic Iron & Steel Co.

Alright! If You Like Motor Trouble— Don't Buy a TR

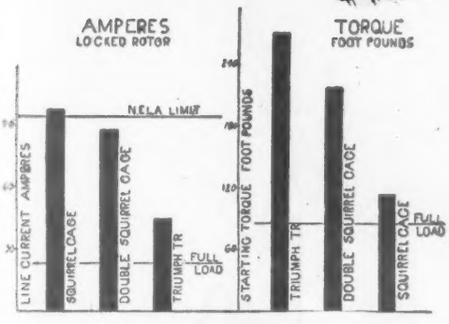
Because motor trouble just naturally evaporates into thin air when the TR Automatic Self Start gets on the job.

It has replaced motors a third larger—done a better job in so many places we've lost count.—We'll send you records of some of them if you write us.

Maintenance—it hardly has any. It's a motor you can put on the job and forget.



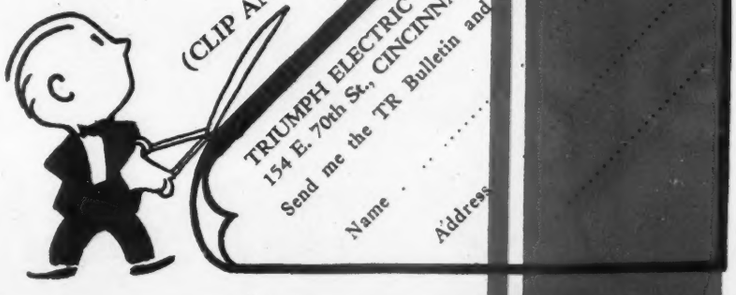
Here's the motor for that job



Starting Characteristics Compared

TR Motors show far higher starting torque — much lower starting current. Starting current is way below N.E.L.A. limit.

THE TRIUMPH ELECTRIC CORP.
CINCINNATI, OHIO


(CLIP AND MAIL TODAY)
TRIUMPH ELECTRIC CORP.
154 E. 70th St., CINCINNATI, OHIO
Send me the TR Bulletin and full information on TR
Name .....
Address .....

TRIUMPH

BUILDERS OF MOTORS SINCE 1892

NORMA-HOFFMANN

PRECISION BEARINGS

"NORMA"
PRECISION BALL BEARINGS

For all ordinary load conditions and for all speeds up to 50000 R.P.M. or even more.

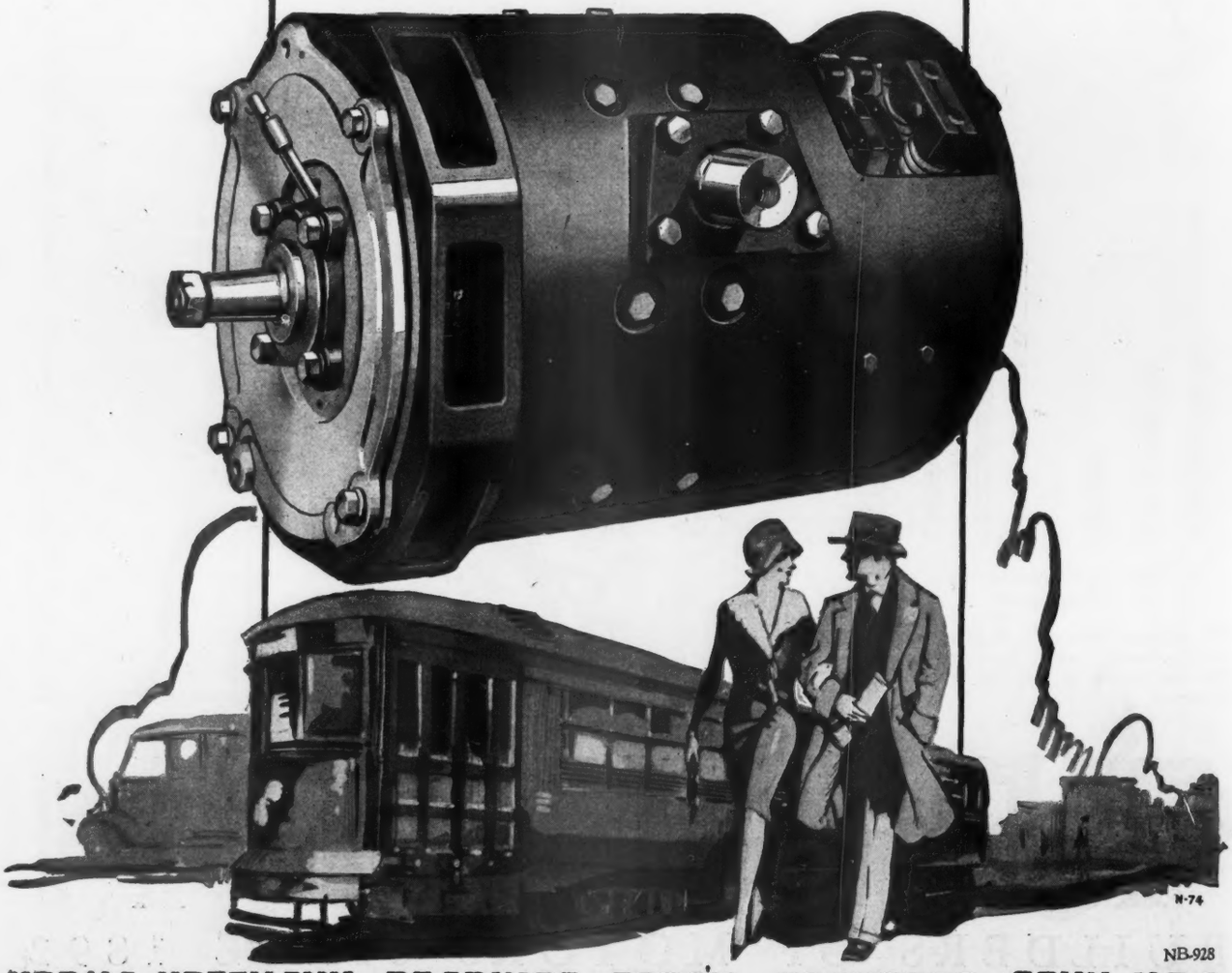
Catalog 905

THIS new Westinghouse No. 1425 Traction Motor is designed for use with the increasingly popular double-reduction-drive trucks—one of the strongest features of which is quiet operation. NORMA-HOFFMANN Precision Bearings, both ball and roller, are standard equipment on this motor. They were selected not only for their proved superior load-ability and shock-ability under heavy duty, but also for their distinctive quiet-running feature.

"HOFFMANN"
PRECISION ROLLER BEARINGS

For high or low speeds, heavy loads and hard service involving shock, jar and overloads.

Catalog 904



NB-928

NORMA-HOFFMANN BEARINGS CORP'N.—STAMFORD, CONN. U.S.A.

Just a twist of the wrist —that's all

Easy to handle, easy to install, built to withstand the hardest kind of service and sold at a price that is attractive . . . these are the features that have made the Condit Type N-4 the most popular switch for small motors, 5 H.P. or less.

It comes manually operated or with push button control, and with or without thermal cutouts for overload time-lag protection.

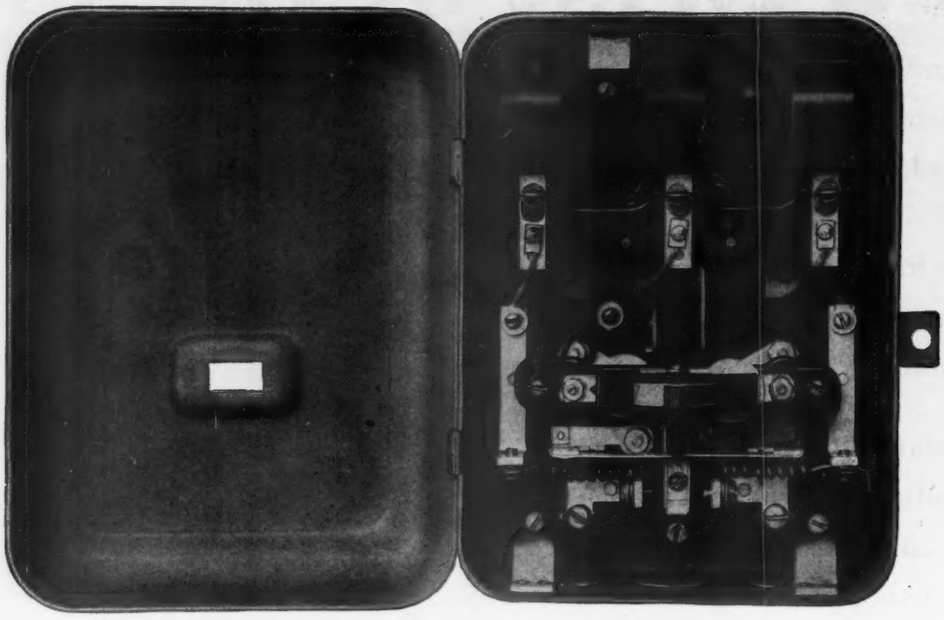
CONDIT ELECTRICAL MFG. CORPORATION
Manufacturers of Electrical Protective Devices
BOSTON, MASS.
Northern Electric Company
LIMITED
Distributors for the Dominion of Canada

Type N-4

1920

Specifications: *3 or 4 pole; standard sizes 30 amperes, 600 volts. For small motors, 5 H.P. or less. Approved by Underwriters.*

CONDIT



Another Diamond E *Magnetic Switch*

[IMPROVED *TYPE* KXR]

AGAIN DIAMOND E presents an Improved Magnetic Switch—Type K X R. Exclusive in design, it has many special features that make it the desirable magnetic switch for single and polyphase Induction Motors. It answers the need for a compact, trouble-proof switch.

With utmost compactness and convenience Type K X R Switch offers the greatest economy in installation and service ever achieved in a magnetic switch. Its refined design and careful manufacture insure perfect operation for *all* services.

These very desirable features are included in K X R: Panel Base and Arc Shields of Bakelite, extremely light and durable. Big copper contacts; large wiping action. Connects directly *across-the-line* in starting. Inverse time limit and thermal overload relay with interchangeable heating elements. Lever of brilliant red Bakelite set integral with the panel. Small in size—only 3 supporting screws necessary. Handsome drawn cabinet finished in black, baked enamel. No sharp corners.

K X R Improved Type Magnetic Switch effects a substantial saving in *space, time* and *labor* on any Induction Motor installation.

Price list and complete Specifications, including Wiring Diagrams, upon request.

Special Features

Easily Removable Panels
The K X R panel may be removed within a few seconds —immediate accessibility at all times.

3 Times Ordinary Wiring Space
Extra large wiring space *behind* the panel makes installation and servicing many times quicker and easier than old-style switches.

Knockouts On All Sides and Back
16 Knockouts on back and sides to meet *every* wiring requirement.

Just the Size of Your Hand
Your outspread hand easily covers the K X R Switch. It can fasten right on the machine it operates. Smaller than most switches but has three times greater wiring space.

DIAMOND ELECTRICAL MANUFACTURING COMPANY INC.

FACTORIES:

LOS ANGELES, CALIF.	HOUSTON, TEXAS	MILWAUKEE, WIS.	SAN FRANCISCO, CALIF.
1318-1362 E. 16th St.	1517 Fannin St.	926 Juneau Ave.	1264 Folsom St.

DISTRIBUTING OFFICES

PORTLAND, OREGON	SALT LAKE CITY, UTAH
218 Commonwealth Bldg.	228 South West Temple St.

ASSOCIATED MANUFACTURERS AND EASTERN DISTRIBUTORS:
UNION ELECTRIC MFG CO., Milwaukee, Wisconsin

Chain Mortality Decreased-

by Balanced Construction

Balanced Chain Design, in which all parts are properly proportioned to carry the load, predetermines a long life for Jeffrey Chains.

They are designed to equally withstand the stresses of the several mechanical forces to which they are subjected, such as tension in the side bars, bending and shearing of the pins and bushings, fixed bearing of the pin in the side bars and wearing between the pins and the bushings. In balanced construction, there is no excess weight of metal.

These are a few of the reasons why Jeffrey Chains replace themselves. For example, Mr. P. A. McLeod, Engineer, Northern Indiana Public Service Company, says, "The first Jeffrey Elevator installed at our Lafayette plant remained in active service several years longer than we could reasonably expect, therefore, it was only logical that we should choose Jeffrey Chains and Buckets to replace it when worn out."

Our new Chain Catalog No. 416-AA makes it easy to select the Jeffrey Chain you need. May we send you a copy?

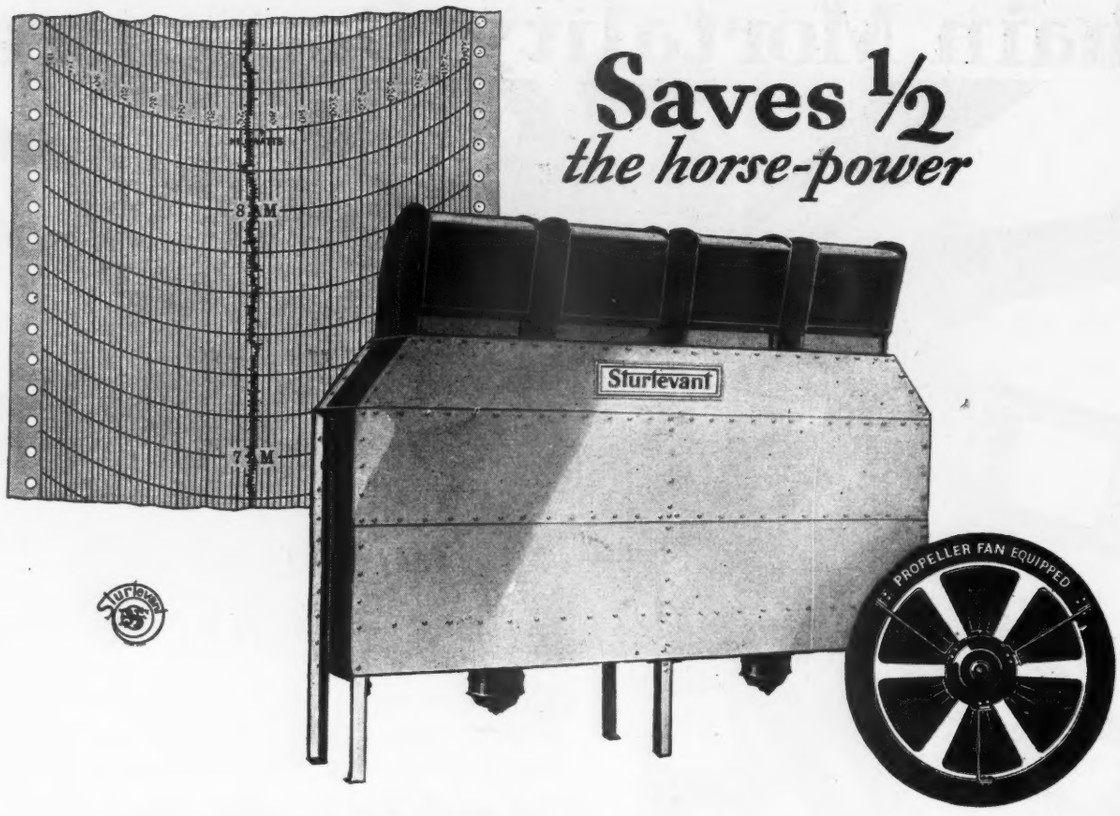
The Jeffrey Manufacturing Company
951-99 North Fourth St., Columbus, Ohio

New York	Boston	Chicago	Utica
Buffalo	Scranton, Pa.	Charleston, W. Va.	Atlanta
Rochester, N. Y.	Cincinnati	Milwaukee	Salt Lake City
Philadelphia	Cleveland	St. Louis	Birmingham
Pittsburgh	Detroit	Denver	Houston
		Montreal	

51 YEARS OF SERVICE TO INDUSTRY

JEFFREY
MATERIAL HANDLING EQUIPMENT

Jeffrey Products
Elevators—Conveyors
Portable Loaders
Coal and Ashes Handling Equipment
Skip Hoists
Chains and Attachments
Sprocket Wheels—Gears
Crushers—Pulverizers
Sand and Gravel Handling, Washing and Screening Equipment
Locomotives
Coal Mine Equipment
Tipple Equipment
Ventilation Fans



Saves ½ *the horse-power*

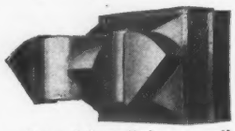
You can *see* this Heater save the dollars!

This Unit Heater effects a saving of 50% in current through the use of propeller type fans instead of centrifugal fans

BY the common-sense application of propeller type fans to "Tempervane" Heating Units, Sturtevant Engineers considerably cut the cost of industrial heating. It does not need the judgment of a Solomon to recognize what this economy means—you simply check the current consumption curve!

For any air delivery or B. T. U. capacity Sturtevant propeller fans require motors only one half the horsepower of those used in similar heating units equipped with housed centrifugal type fans . . . it means motor horsepower is cut 50% and current consumption is halved!

A 50% saving in current consumption is a worth-while saving—it deserves investigation! Write our nearest office for indisputable evidence of Tempervane economy—complete information, test photographs, performance curves, etc., will be promptly furnished . . . gratis.



Suspended type "Tempervane"

Tempervane Heating Units are made in both floor and overhead types—for steam pressures up to 350 pounds per square inch.

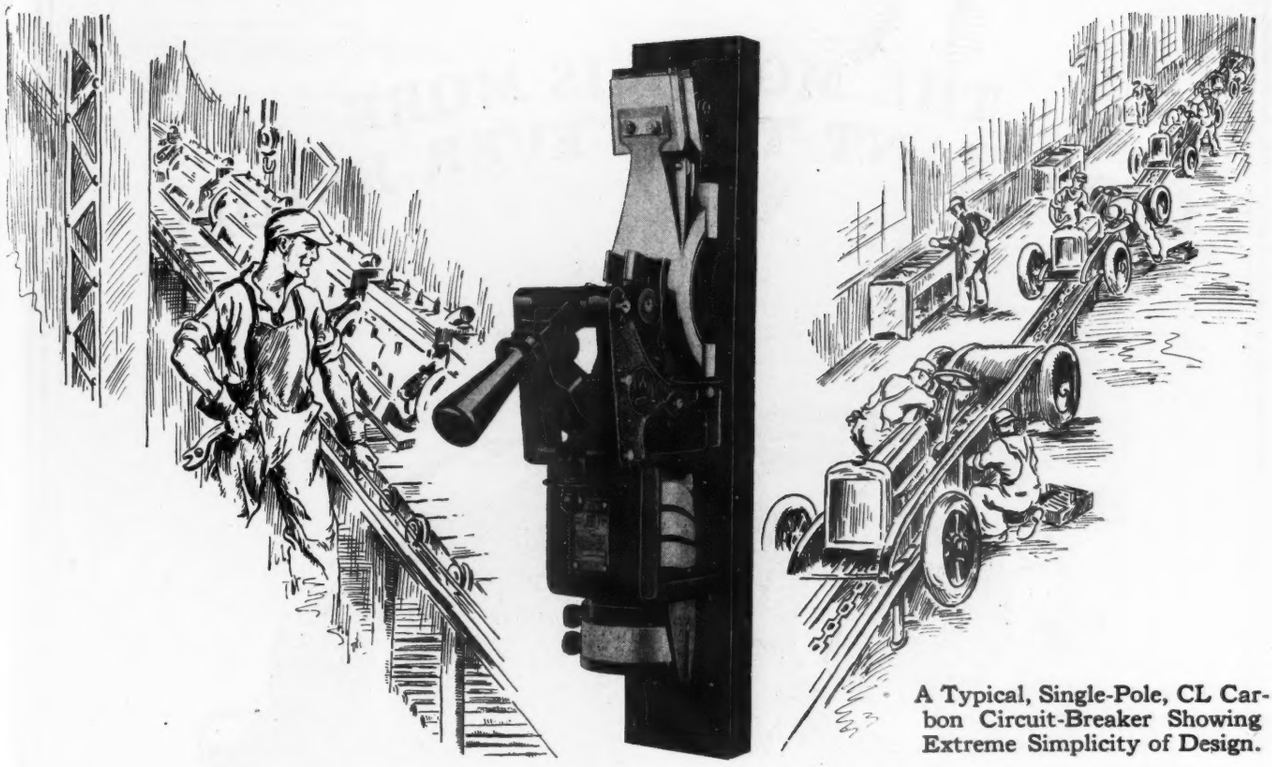
B. F. STURTEVANT COMPANY

Plants and Offices at: Berkeley, Cal. ∽ Camden, N. J. ∽ Framingham, Mass. ∽ Galt, Ontario ∽ Hyde Park, Mass. ∽ Sturtevant, Wis.

Branch Offices at: Atlanta; Birmingham; Boston; Buffalo; Camden; Charlotte; Chicago; Cincinnati; Cleveland; Dallas; Denver; Detroit; Hartford; Indianapolis; Kansas City; Los Angeles; Milwaukee; Minneapolis; New York; Omaha; Pittsburgh; Portland; Rochester; St. Louis; San Francisco; Seattle; Washington, D. C.; *Canadian Offices at:* Toronto, Montreal and Galt.

Also Agents in Principal Foreign Countries.

Sturtevant REG. U.S. PAT. OFF. *Tempervane* **Heating Units**



A Typical, Single-Pole, CL Carbon Circuit-Breaker Showing Extreme Simplicity of Design.

CL Carbon Circuit-Breakers *fit modern industries*

THE prime consideration of modern plant equipment is simplicity and neatness. This is natural, since service records have established that equipment having these features is dependable.

Westinghouse CL carbon circuit-breakers are simple and neat. There is no complicated system of ugly rods and levers. Even the framework has been reduced to the simplest, neatest form consistent with strength. Years of hard usage bear witness that these features of the CL breaker spell dependability and durability.

Permanence of appearance is assured by treating all exposed copper parts with a satin finish, which retains its lustre without polishing.

Circular 1705 fully describing these breakers can be obtained from our nearest district office.

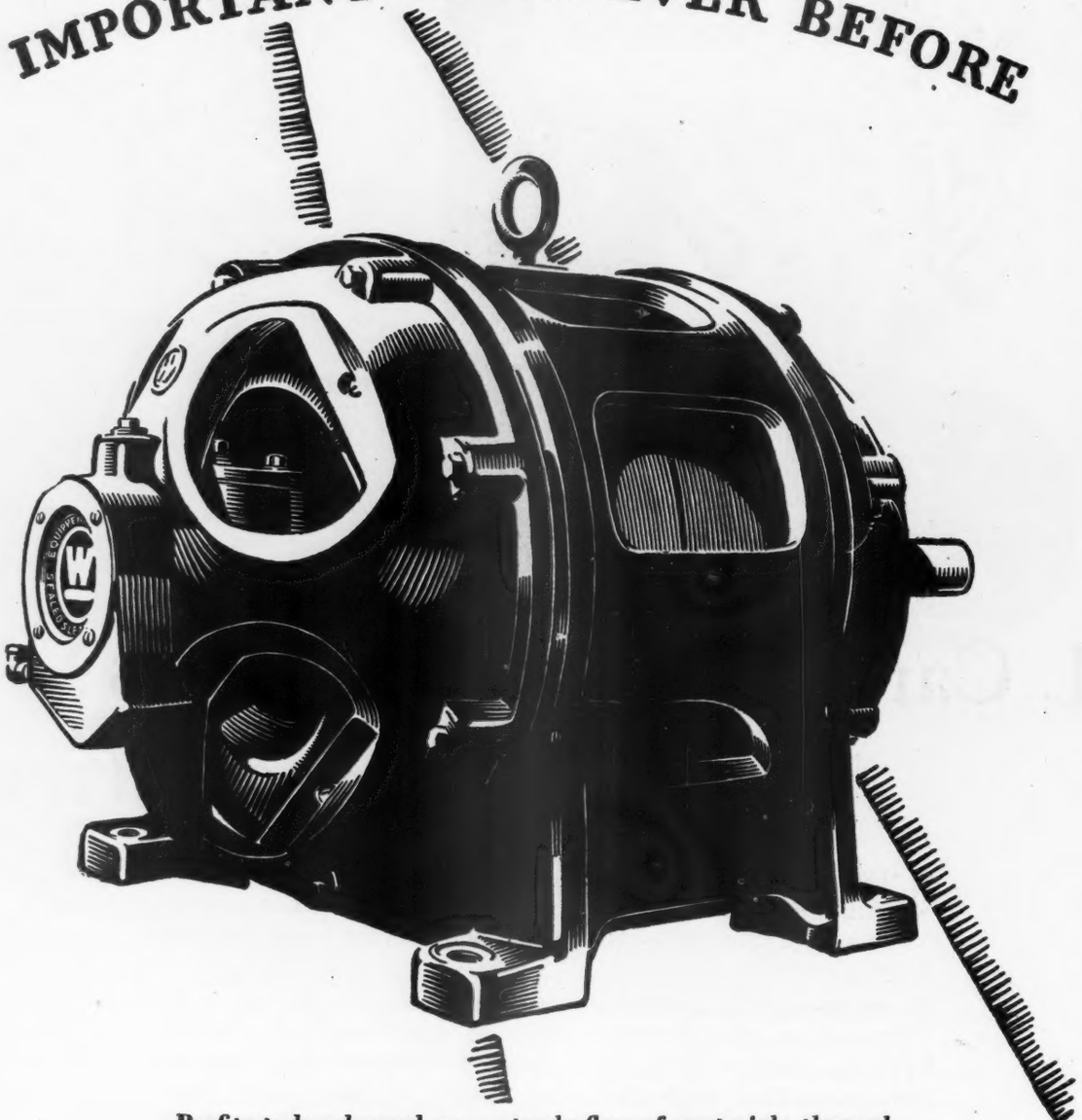
Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania

Sales Offices in All Principal Cities of the United States and Foreign Countries

T 30221

Westinghouse

THE MOTOR IS MORE IMPORTANT THAN EVER BEFORE

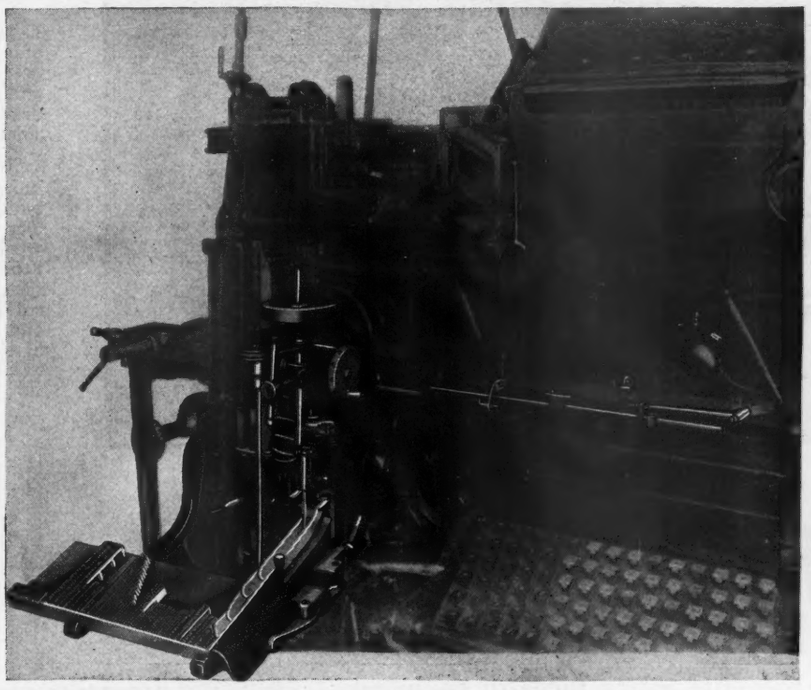


Profits today depend on a steady flow of materials through mutually dependent production operations. The motors responsible for this continuous movement have taken on a new importance. Their constant performance is vital in modern production. ' ' ' Every Westinghouse motor embodies one fundamental purpose—to deliver a rated horsepower, without fail, in years of continuous service.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh Works, East Pittsburgh, Pa.
Sales Offices in all Principal Cities of the United States and Foreign Countries

Westinghouse Motors
With Sealed-Sleeve Bearings

X-98179



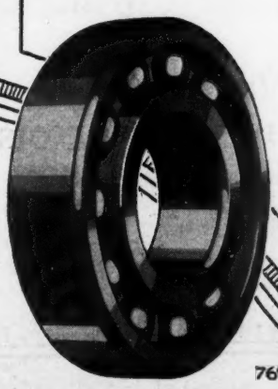
THIS Mohr Lino-Saw is an instance of where New Departure Ball Bearings are used to secure unfailing accuracy of mechanical operation. It automatically saws type slugs to fractional inch dimensions, the cut being controlled by micrometer adjustment.

To accomplish this, New Departure Ball Bearings are used. Their correct design produces true rolling motion, allowing freest operation of all moving parts.

Important to applications such as this is the fact that New Departures never require readjustment and indefinitely maintain original location of parts to which they are applied.

Write for Application Data Sheets, furnished without obligation to bearing users. Resident representatives in industrial centers.

The New Department Manufacturing Company, Bristol, Connecticut; Chicago, Detroit and San Francisco.



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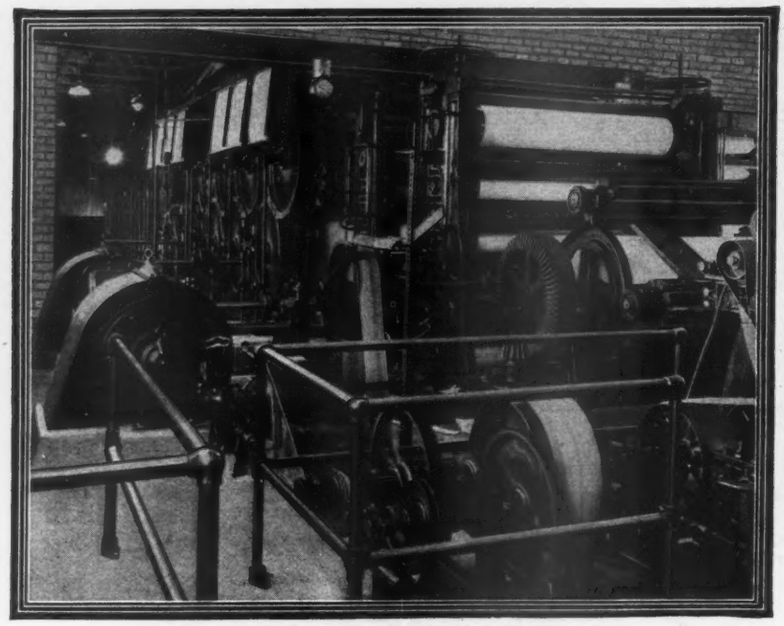
New Departure Quality Ball Bearings



Correct Lubrication
is Essential

Lubrication is no less a tool of production than the highest priced machine in your plant, and the selection of lubricants deserves equally careful consideration.

Frequently, to obtain proper lubrication, a careful investigation by experts is necessary. The Standard Technical Staff, working for years between our refineries and varied industries, has become expert in solving lubrication problems and has developed a full line of efficient lubricants for practically every industrial need.

What Expectation of Service

Every machine, every piece of equipment may be said to have a definitely limited exception of service life. And vigilant maintenance is an important factor in carrying any equipment through to its expected length of usefulness.

As every maintenance man knows, proper lubrication is a definite positive factor in equipment life, in operating efficiency. Probably no other element entering into equipment maintenance will pay larger dividends if studied carefully and intelligently, than lubrication.

So important did the French Paper Company consider lubrication that when they rebuilt the drive of one of their paper machines, a most careful study of lubrication requirements was made to assure the efficiency of operation. After six months of operation this company says:

"This machinery has been in operation for six months now and we are happy to say that we are not disappointed in our selection of Standard Oil Company (Indiana) products."

When the proper Standard Lubricant is used on any equipment, lubrication is as nearly perfect as lubrication can be. To insure the correct use of Standard Oils and Greases, the Company places the services of its lubrication engineers free of charge, at the disposal of any manufacturer throughout the Middle West.

STANDARD OIL COMPANY *(Indiana)*

General Offices: **910 S. Michigan Ave.** **CHICAGO, ILLINOIS**

ILLINOIS	INDIANA	IOWA	S. DAKOTA	N. DAKOTA	MINNESOTA	MISSOURI
Chicago	Evansville	Davenport	Huron	Fargo	Duluth	Kansas City
Decatur	Indianapolis	Des Moines	MICHIGAN	Minot	Mankato	St. Joseph
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Peoria	KANSAS	Sioux City	Grand Rapids	La Crosse		
Quincy	Wichita		Saginaw	Milwaukee		
				Green Bay		

1411

The sign of success

G R O W T H

WHILE the long experience we have had in the carbon industry is significant to the users of carbon products, it is not the only guide for them to follow. History lends prestige to an institution, and age is an asset. But there are many old companies that are no larger than they were when they started—they did not grow.

Growth is an evidence of success. We have grown steadily since the pioneering days of the carbon industry, and we are still growing. Our growth has been due to the ability to supply quality products, to meet modern requirements, and to use our experience in giving our customers an ever higher type of service.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

Carbon Sales Division

Cleveland, Ohio — SILVER STRAND CABLE TRADE MARK REGISTERED — San Francisco, Cal.

Branch Offices and Factories

CHICAGO, ILL. PITTSBURGH, PA. JERSEY CITY, N. J. BIRMINGHAM, ALA.

Design Your Own Panels with These Standard Units

Complying with the Safety Code of the U. S. Bureau of Standards

Simplify your panelboard requirements with Bull Dog SAFtoFUSE Units—the combined Switch and Cut-Out. Select the units required, combine them in a panel and provide blank filler units in spaces for future circuits. When the equipment is moved the units go with it to the other panel. Bull Dog SAFtoFUSE Panels take care of every present and future requirement with utmost simplicity and economy.

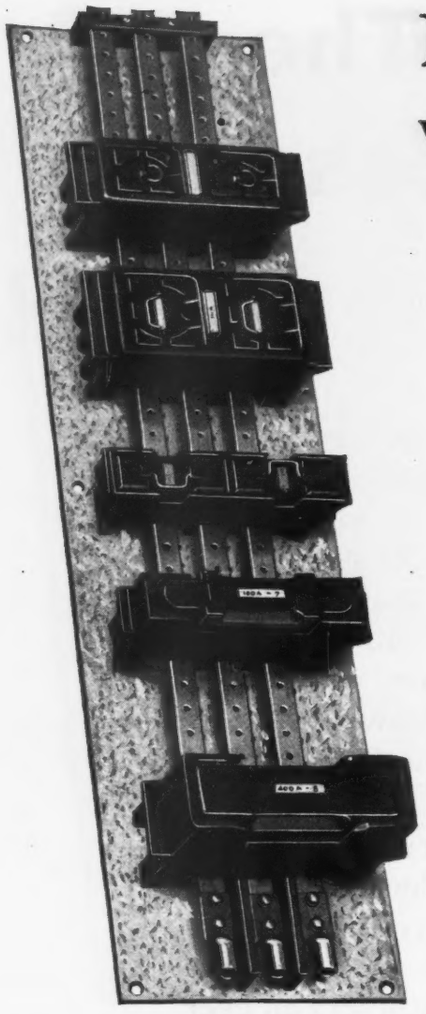
Interchangeable—All units are of the same standardized 11-inch width and fit on the same busbar drillings.

Capacities—30 to 400 amperes, 250 volts. 30 to 200 amperes, 440-600 volts. Standardized cabinets take all units.

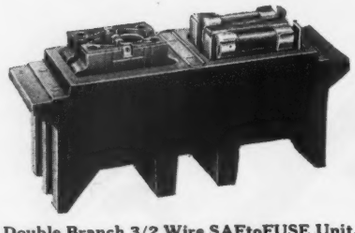
Future Circuit Provisions—Additional units can be mounted at any time to take care of new circuits. Only a screw-driver is needed for the mounting work. Blank filler plates cover the busbars in unused units.

Convertible—Several of the units are convertible from 30 amperes, to 200 amperes, 250 volts and 30 amperes to 100 amperes, 440-600 volts.

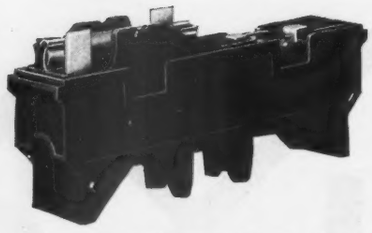
BULLDOG ELECTRIC PRODUCTS CO.
DETROIT, MICHIGAN



SAFtoFUSE Units.
Mounted on Busbars and plate.
All units fit same Busbar drillings.

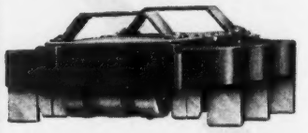


Double Branch 3/2 Wire SAFtoFUSE Unit.
30 Amp. or 60 Amp. 250 volts.
One head in "on" position, the other "off".

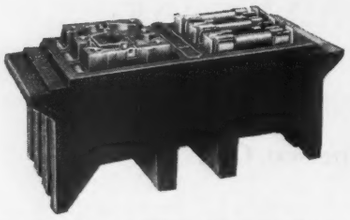


Twin Head, SAFtoFUSE Bakelite Unit.
30 Amp.-60 Amp. 440/600 Volts or 100 Amp. 250 Volts.

BLANK FILLER UNITS to cover unused Busbar space pending installation of future circuits.

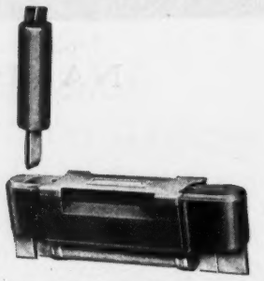


Method of connecting heads together for 2 or 3 pole, if desired.



Double Branch 3/3 Wire SAFtoFUSE Unit.
30 Amp. or 60 Amp. 250 volts.
One head in "on" position, the other "off".

Single Pole, SAFtoFUSE Unit.
400 Amp. 250 Volts. In "off" position.



Special Type of Head with Jack for Motor Reading where required in large installations.

BULL DOG
SAF TO FUSE
PANELBOARDS

Underwriters' Approval

Safety—SAFtoFUSE Units are approved as a "combination switch and cut-out." Fuses must necessarily be disconnected from the line before they can be touched, *as recommended by the U. S. Bureau of Standards Safety Code.* Contact with live metal parts is practically impossible. Means for testing fuses are provided.

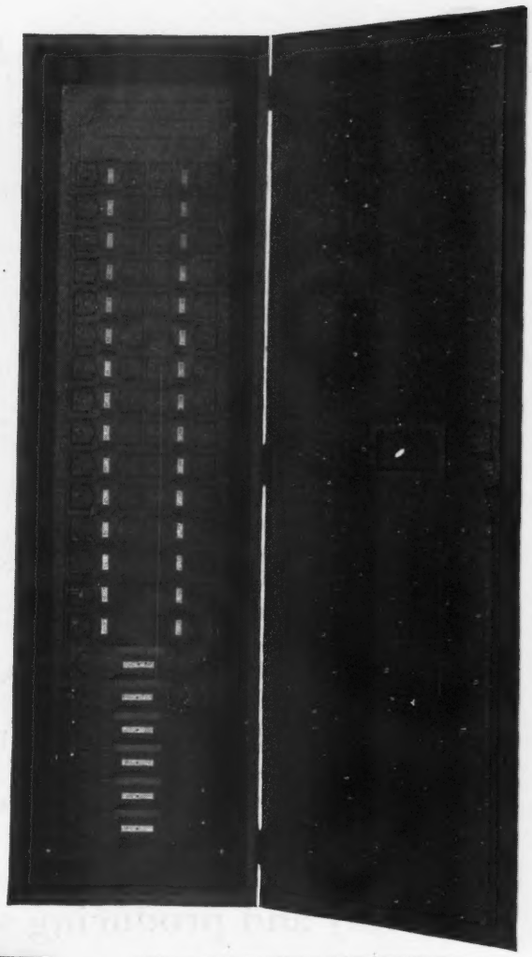
Narrow Cabinets—Standard cabinets are 19 in. wide, which allows 4-inch wiring gutters on all sides. They conveniently fit on columns, pillars or other narrow spaces, saving room and shortening runs to equipment. If panel is located in sight of motor, a disconnect switch for motor is not required.

Value at Low Cost—In properly designed installations the cost of Bull Dog Panels is lower than live face panels. Large quantity production enables us to offer many times the value formerly given in obsolete live face panels.

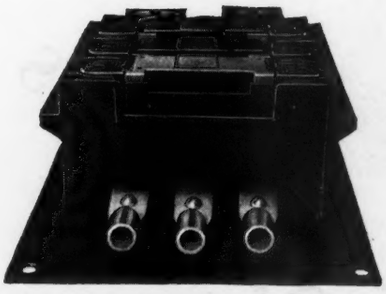
SAFtoFUSE Panels are endorsed by successful use under severe conditions in hundreds of installations throughout the country.

Representatives in every large city ready to serve you.

BULLDOG ELECTRIC PRODUCTS CO
DETROIT, MICHIGAN

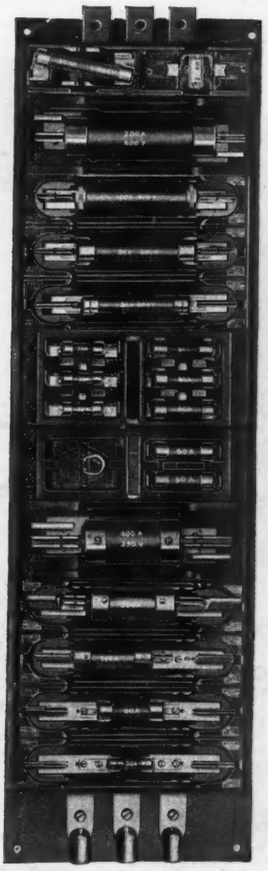


3 Phase 440-600 Volts SAFtoFUSE Power Panelboard. Twin Heads, 30-60-100 Amps. Single Heads 200 Amp. capacity.

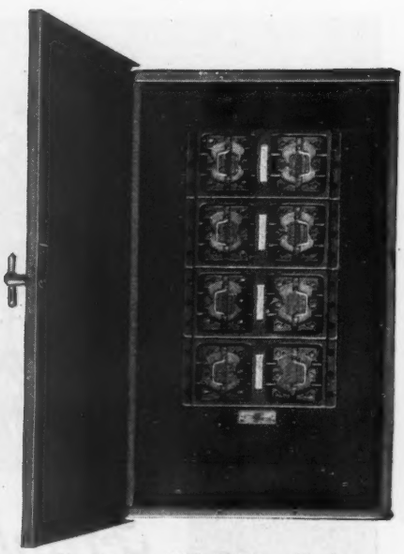


End View of SAFtoFUSE Units in "on" position. Fuses may be tested in this position but otherwise cannot be touched until disconnected from the line.

"BULL DOG" Dead Front Super-Safety Switchboard using SAFtoFUSE Units for Branch Circuits. Main Switches in bottom section.

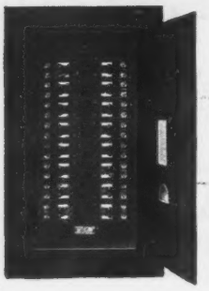


Composite photograph showing the standardized construction and the flexible, convertible and interchangeable features of "BULL DOG" SAFtoFUSE Units.



Standard SAFtoFUSE Feeder Panelboard 30 and 60 Amp. 250 Volt 3/3 wire 8 circuits.

FA Service to Factory Electricians comprises an experienced sales engineer in each of thirty cities to aid you in solving many problems of switchboard and panelboard installations, together with prompt estimates giving the right price first and service as long as the job requires. FA Service also provides steel cabinet stocks in Jobbing Houses all over the country and complete panelboard stocks in each of thirty district offices. Also local assembly and producing shops in twelve important territories.



Frank Adam
ELECTRIC COMPANY
ST. LOUIS

DISTRICT OFFICES

Atlanta, Ga.	Kansas City, Mo.	Richmond, Va.
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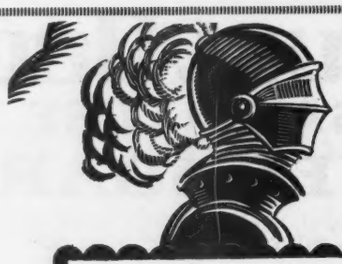

ARMORED IN DELTABESTON

Armored in Deltabeston wire, electricity is equipped to fight your battles . . . Impervious to fire, to water and to reasonable mechanical abuse, Deltabeston's stone-like felted asbestos covering protects your circuits as his armor protected the knight of old . . . See Graybar, for samples.

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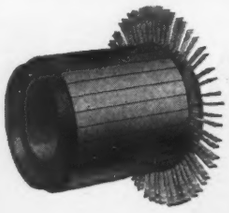
Distributed by Graybar Electric Company



Replacement Commutators

SHIPMENT of any size up to 15 inch diameter can be made within 5 days after receiving V-rings.

MANUFACTURED from Hard Drawn Copper bars. (Guaranteed to be free from all blow-holes). Insulated with pure amber mica of high dielectric strength. Tested for breakdown on 2200 volts. Speed tested at 3600 RPM.

Our prices will agreeably surprise you.

The Fuerst-Friedman Co.
1284 East 53rd St. Cleveland, Ohio

Close inspection of Radiotron bases in the General Electric plant at Pittsfield, Mass., demands good seeing conditions to reveal every detail.

301 © C. H. E. Co., 1928

What makes a light good for inspection and other close work?

BETTER THAN DAYLIGHT

Not a mere claim— a statement of fact

Cooper Hewitts are better than daylight not only because they give constant intensity 24 hours a day but because they yield 90% yellow-green (the best seeing) rays, and have none of the glare-producing qualities which are hard on the eyes. As a result, every detail becomes sharp and clear as if magnified, vision is more acute and the response of brain and hand is more rapid.

INSPECTION operations require good vision, and good vision demands light of high revealing power.

Scientific study has proved and industrial experience has confirmed that the light of highest revealing power should be as nearly as possible of one color and that yellowish-green light produces the greatest visual effect for a given expenditure of energy (or electric current). Glare also must be avoided.

Fortunately these conditions are fulfilled by Cooper Hewitt light 90% of which is composed of yellow-green rays. It is primarily this fact which accounts for the rapidly increasing use of Cooper Hewitts in so many industries.

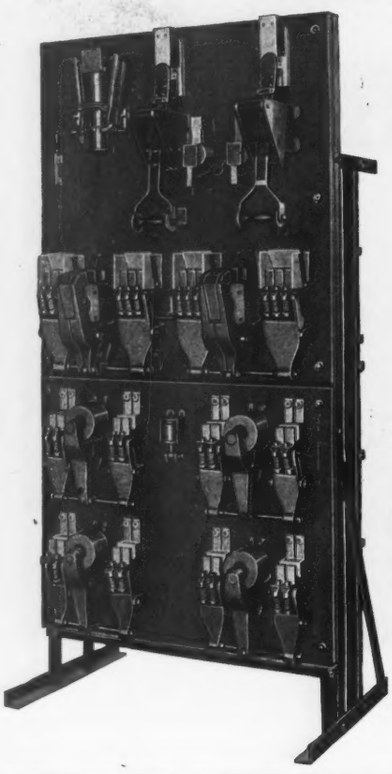
This modern form of lighting reveals numerous defects which remain hidden in other kinds of lighting. Outlines become sharper and the general effect is one of magnification. This makes Cooper Hewitts ideal for both inspection and production, and often used even in preference to daylight.

If you would like to be shown, a trial installation in your own plant will be made without obligating you. Why not accept this offer,—today? Cooper Hewitt Electric Company, 817 Adams St., Hoboken, N. J.

COOPER HEWITT

A General Electric Organization

One of Sundh's many specials



A Definite Time-Current Modified Automatic Starter

A load to be started—no two starts the same—motor must be protected always. Solution to this problem—a current modified, definite time limit starter. It automatically adjusts the acceleration to avoid dangerous peaks of current and torque.

SUNDH ELECTRIC COMPANY, INC.

RELIABLE CONTROL

Parkhurst St. at Ave. C Newark, N. J., U. S. A.

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MARTINDALE MOTOR MAINTENANCE EQUIPMENT

HULLHORST MOTOR DRIVEN UNDERCUTTERS

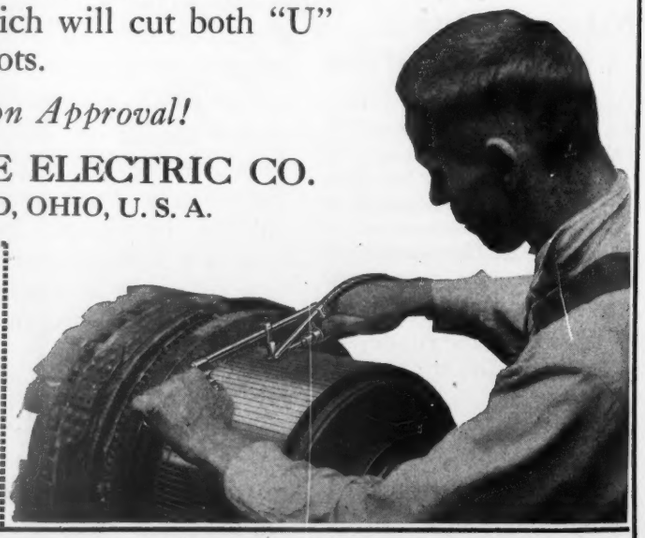
for Slotting Commutators

7 Different Types from which to make selection—5 of which will cut both "U" and "V" shaped slots.

Shipped on Approval!

MARTINDALE ELECTRIC CO.

CLEVELAND, OHIO, U. S. A.



MARTINDALE ELECTRIC CO.,
1252 W. 4th St., Cleveland, Ohio, U. S. A.

Send me your No. 9 Catalog of 24 pages illustrating and describing Hullhorst Undercutters and other interesting and useful Commutator Slotting Equipment.

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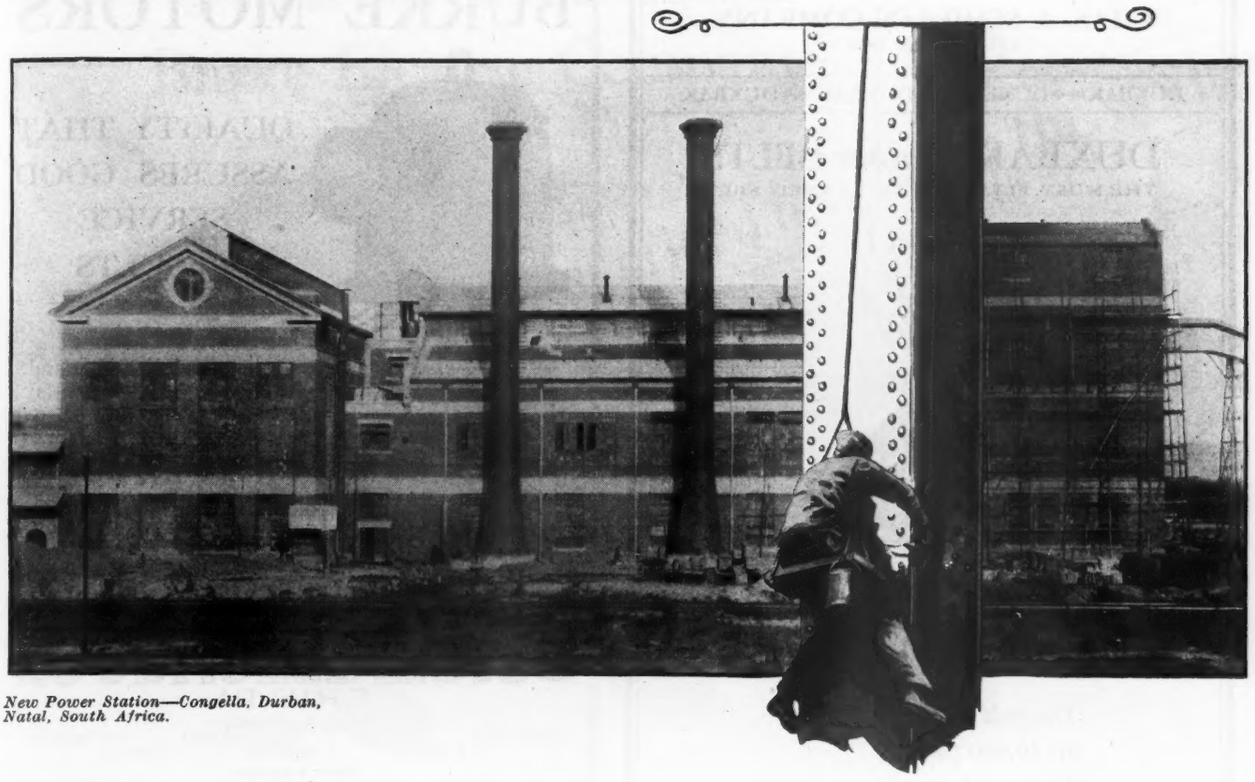
Street and Number .....

City and State .....

By (name and title) 12/28

MARTINDALE MOTOR MAINTENANCE EQUIPMENT

SERVICE DATA FOR PROTECTIVE PAINT USERS - - - - - - - CASE NO. 9



New Power Station—Congella, Durban, Natal, South Africa.

World wide recognition . . . Dixon's **Paint**

At Natal, South Africa, an internationally known engineering organization (name on request) recently completed the power plant shown above. The stacks were protected with Dixon's Silica-Graphite Paint—a logical choice by these engineers due to their intimate knowledge of the service this paint had given their organization in the United States and elsewhere throughout the world.

For the fame of Dixon's Silica-Graphite Paint—10 . . . 12 . . . 15 . . . and even 20 years of active protective life under varying degrees of severe service conditions is not confined to the United States. The Air Ministry and Admiralty of England as well as many of her representative industrialists, railroads and municipalities specify it. India, Chile, Bolivia, Argentine, the Philippine Islands, South Africa, Brazil, in fact throughout the world, bridges, power plants, iron and steel structural work, tanks, train sheds and industrial buildings are protected from rust, corrosion and process deterioration by this unusual protective paint.

Yes, Dixon's comes in several serviceable colors

Many people think of Dixon's Silica-Graphite Paint as unattractive. Actually it gives a fine durable semi-gloss finish, and it may be had in three tones of gray, dark red, green and black. There is also Dixon's Aluminum Graphite Paint for a silver-gray heat-reflecting finish.

JOSEPH DIXON CRUCIBLE COMPANY
JERSEY CITY, NEW JERSEY
Established 1827

D X N TRADE MARK

Our booklet No. B-75, in addition to a complete discussion on the physical and protective properties of Dixon's Silica-Graphite Paint, gives also an impressive list of users throughout the world. Know its protective qualities, its uses and its users by sending for your copy today!

DIXON'S SILICA GRAPHITE PAINT

Adequate Protection at Minimum Ultimate Cost

CHAS. A. SCHIEREN COMPANY
ESTABLISHED 1868

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DUXBAK *Leather* BELTS

THE MOST PLIABLE OAK-TANNED BELT

It Saves Money for

10,000 PLANTS

Duxbak Belts are used
In 10,000 plants
Because they are so
Satisfactory in every
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It pays to spend *enough*
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Send for These Pamphlets: "The Seven Factors of Belting Economy"

Please put my name on your mailing list to receive "THE SEVEN FACTORS OF BELTING ECONOMY" as they are published.

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72 FERRY STREET NEW YORK
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BURKE MOTORS

QUALITY THAT ASSURES GOOD SERVICE RESULTS

Burke Motors are of correct mechanical design and correct electrical design. Highest grade material and workmanship. High average efficiency and long life. Accurate inspection before shipment.

"BURKE FOR WORK"

The Burke line also includes Alternators, D. C. Generators, Motor Generator Sets and Electric Arc Welders.

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A-C-E

Coil making machines offer the latest in modern equipment for coil making.

Our machines are the simplest and less expensive and are being used by thousands of concerns throughout the world.

Our trial offer will prove the above facts.

Complete information on request

ARMATURE COIL EQUIPMENT CO.
MANUFACTURERS
2415 Forestdale Ave. Cleveland, Ohio

WORCESTER BLEACH & DYE WORKS CO.
ESTABLISHED 1861
Bleachers, Dyers and Mercerizers of Cotton Yarns and Warps
Winding on Cops, Tubes or Cones
Manufacturers of Cotton Yarns in Fast Colors
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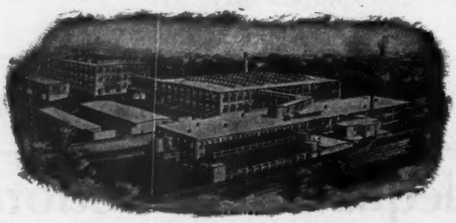
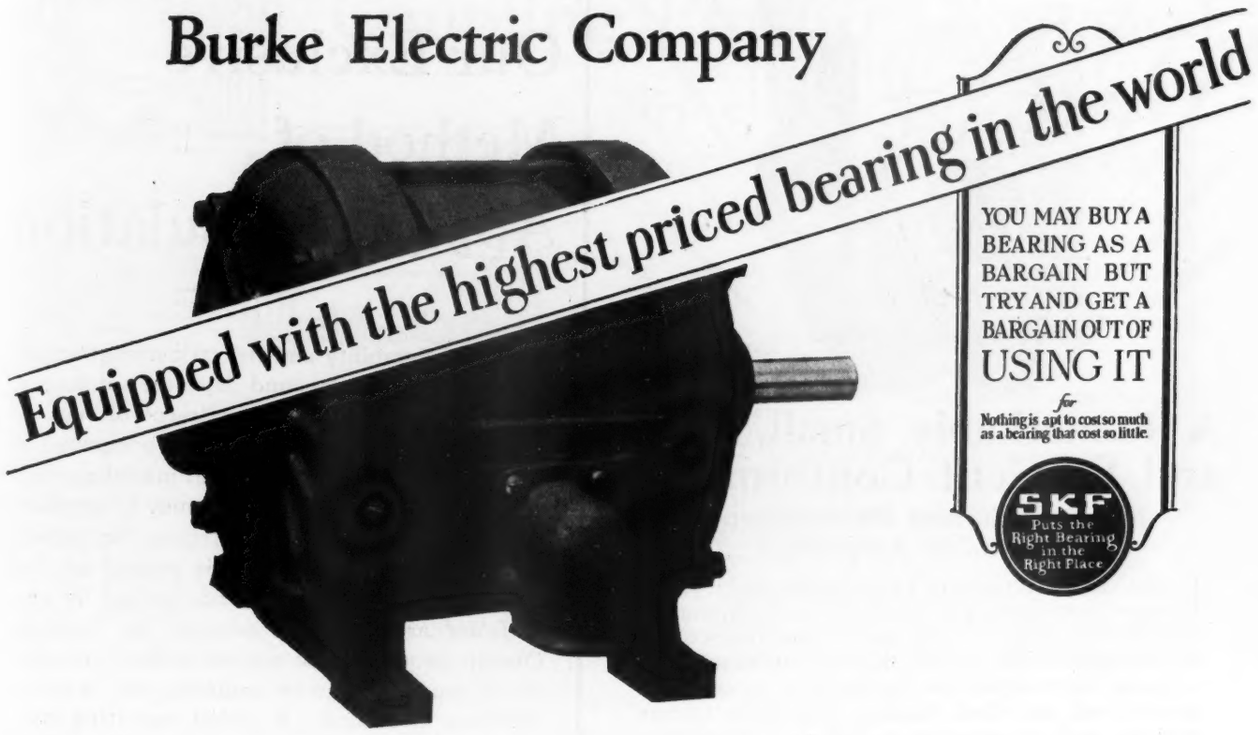
"Sewing and Stitching Threads for All Industries"



Home of Silkslip Braider Thread
WORCESTER, MASS.

ANOTHER ONE OF THE 59 ELECTRICAL MANUFACTURERS THAT USES SKF BEARINGS

Burke Electric Company


Equipped with the highest priced bearing in the world
YOU MAY BUY A BEARING AS A BARGAIN BUT TRY AND GET A BARGAIN OUT OF USING IT
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Nothing is apt to cost so much as a bearing that cost so little.
SKF
Puts the Right Bearing in the Right Place

Motors Large and Small Give the Least Trouble with SKF Bearings

MOTORS everywhere .... large and small .... turning smoothly and easily .... transferring energy without interruption or troublesome maintenance. The march of progress toward such unfailing motor performance has been due in great measure to the use of anti-friction bearings. Today, 59 manufacturers in the electrical industry are using SKF Ball and Roller Bearings because of their many proven advantages.

For years the Burke Electric Company has been using SKF Bearings on motors. Losses of productive time and high repair costs due to bearing wear are reduced to a minimum. SKF Bearings never require any adjustments, maintain initial air gap, eliminate damaged rotors and windings, and require lubricant but three or four times a year. To the ultimate user all these things mean .... service which is the lowest in cost per bearing hour.

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.

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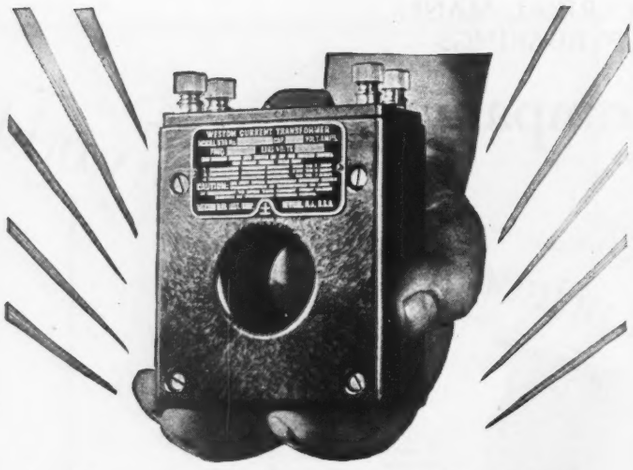
SKF

Ball and Roller Bearings



A Remarkably Small, Light and Efficient Combination

for A. C. Current Measurements 0.2 to 200 Amperes

IN the Model 539 Current Transformer, and its companion instrument the Model 528 A. C. Ammeter, Weston has made a most useful and noteworthy contribution to the art of electrical measurement.

These instruments are handsomely encased in mottled red and black bakelite, and every feature of design and construction is fully in keeping with highest Weston standards. The miniature size and low cost of this equipment make it especially attractive for service where extreme accuracy is not of prime importance and where the expense of major instruments would be prohibitive.

Moreover, it permits of measuring currents under one ampere which is not possible with transformers having five-ampere secondaries. Yet its testing range is sufficiently high to satisfy the great majority of current measuring requirements.

These instruments are useful as auxiliary equipment for central stations; for installing and servicing household appliances; for industrial plants in testing small motors and other electrical equipment; for electrical manufacturers in checking their products; and for numerous other uses met with in the railway, mining, and engineering fields, electrical repair shops, laboratories and educational institutions.

Write now for descriptive literature — of value to every business executive and engineer who is interested in the subject of electrical testing.

Summary of Transformer Characteristics:

Ranges: self-contained —2, 5, 10, 20 amperes; inserted primary—50, 100, 200 amperes. Secondary, one ampere. Secondary burden, 2 volt-amperes maximum. Accuracy, 1% from 25 to 150 cycles. Weight, 2-5/8 lbs. Self-contained ranges are changed by means of a unique range-changing switch — fool proof, positive and easy of operation.

WESTON ELECTRICAL INSTRUMENT CORP.
597 Frelinghuysen Ave. Newark, N. J.

Weston
PIONEERS SINCE 1888
INSTRUMENTS

Our Exclusive Method of Applying Insulation

THE durability and dielectric strength of an insulating compound depends, not simply on the quality and treatment of ingredients, but on the way in which this compound is applied to the wire to assure an insulating wall of equal thickness. Insulation may be applied, for instance, by either the strip or the tubing process. Okonite insulation is applied by the strip method. The compound, backed by tin, is *folded* around the conductor—an *exclusive* Okonite process which assures perfect centering of the conductor and an insulating wall of equal thickness all around. A perfect insulating compound is thus perfectly applied—still another reason why the quality of Okonite Rubber Insulated Wires and Cables has remained a standard during the last fifty years.

OKONITE PRODUCTS

OKONITE INSULATED WIRES AND CABLES
OKONITE INSULATING TAPE
OKONITE CEMENT
VARNISHED CAMBRIC CABLES
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SUPER-TENSION CABLES
IMPREGNATED PAPER CABLES
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The Okonite Company

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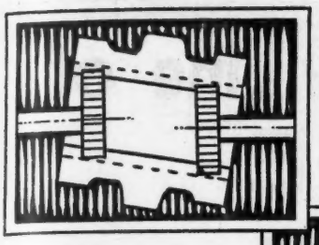
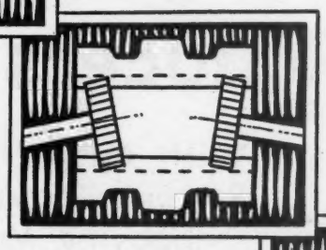
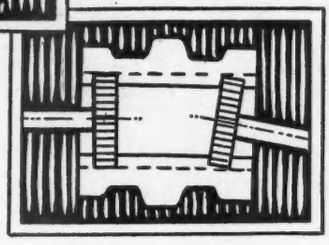


Coupling Practice Reversed

By eliminating flexible materials there is no more replacement problem.





Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.

ANY FLEXIBLE coupling that is built with flexible bushings, pins, springs, discs or grids is throwing you open to "fatigue of materials", which ultimately means coupling failure and shutdown for repairs.

Engineers describe Fatigue as "progressive failure." In couplings it is caused by the repeated bending or alternate compression and expansion of the flexible parts. As long as flexible couplings are built with flexible materials, every plant superintendent must carry replacement parts.

A Revolutionary Idea

Eight years ago Fast's design swept all old practice aside, eliminated flexible materials entirely, and used purely mechanical flexibility. It goes right to the heart of the whole matter and takes the flexible coupling problem out of the replacement class forever.

See in the diagram above, how the floating sleeve is free to take a neutral position, yet the two shaft gears are completly and permanently meshed with the internal gears of the sleeve. This means that simple or compound misalignment is taken up between the gear faces, and the load is actually carried by oil between the teeth, under centrifugal pressure. There is no wear. There is no flexing of anything. The entire operation is purely mechanical.

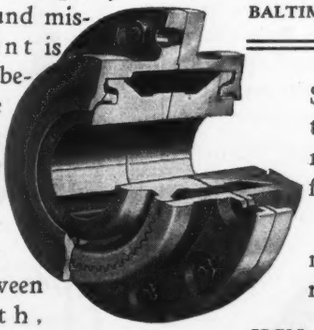
Solve Your Coupling Problem

You can eliminate replacements forever by standardizing on Fast's coupling. You may think that your problem is "different". Maybe it is. Standard Fast's couplings are made in sizes from 1" shafts up to huge steel mill reversing drives. And furthermore there are special designs for mill motor use; for excessive misalignment; a telescopic design for paper jordon and similar use; a cut-out type for quick cut-out of the driven unit; etc. So no matter what your problem, this simple principle of mechanical flexibility can be applied to avoid failure and eliminate costly shutdowns.

FAST'S
Self-aligning
COUPLING

Without flexible bushings, pins, springs, discs, grids or any other flexible materials.

Patented and Manufactured by
The Bartlett Hayward Co.
BALTIMORE, MD.

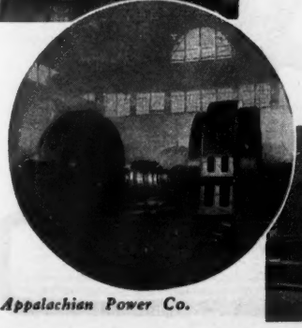


Send for the Book

Do not fail to get the full story. Send for the book that gives full details, everything from the mathematics of design to instruction for figuring and ordering.

Take the first step toward eliminating coupling repairs forever, by reading this free book.

Washington Pulp and Paper Co.



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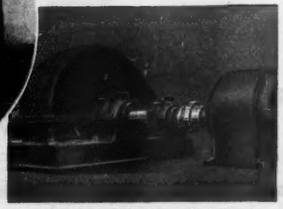

Union Oil Co., California

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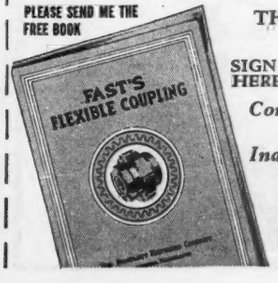
PLEASE SEND ME THE FREE BOOK



THE BARTLETT HAYWARD CO.
200 Scott Street
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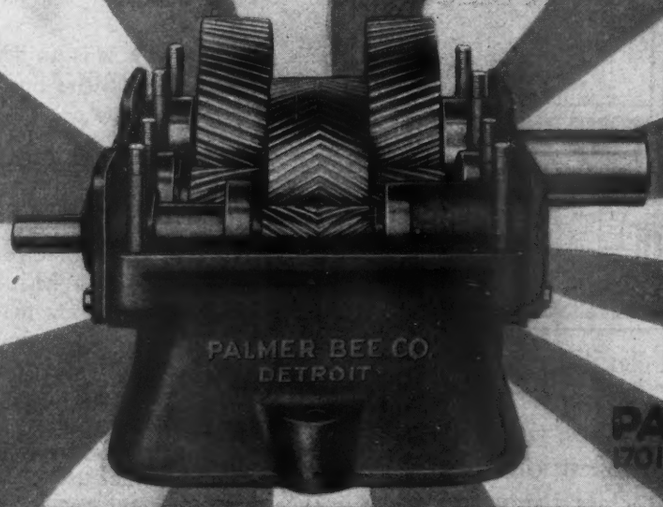
Palmer-Bee Introduces a New Line of HERRINGBONE Speed Reducers



With Anti-Friction Bearings Throughout- Embodying Marked Advantages in Design Construction & Efficiency

Single Types in sizes from 4" to 16" centers. Double types from 10" to 25" centers

Full details on request

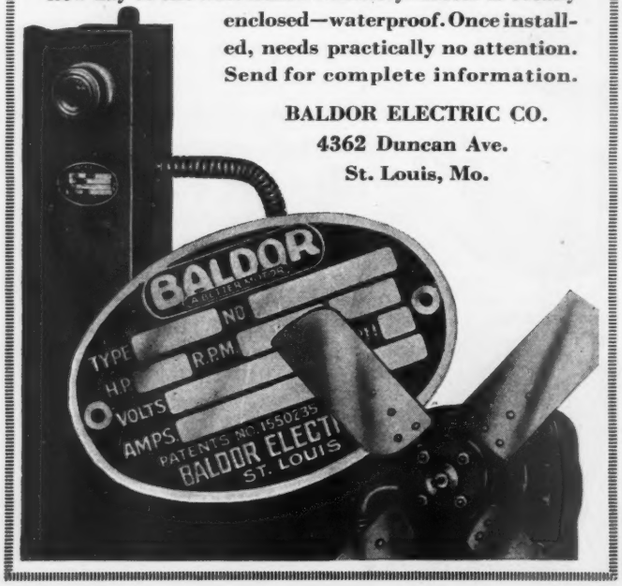
PALMER-BEE COMPANY
1701-1713 POLAND AVE. DETROIT, MICH.

Palmer-Bee Spur Herringbone Helical **Speed Reducers**

NEW MOTOR REVOLUTIONIZES UNIT HEATER INDUSTRY

The speed of the Adjustable Varying Speed Baldor Condenser Motor is controlled by a turn of the switch, thus providing for a variation of the number of heat units thrown off by the heater. This motor brings a new day to the unit heater industry. Motor is totally enclosed—waterproof. Once installed, needs practically no attention. Send for complete information.

BALDOR ELECTRIC CO.
4362 Duncan Ave.
St. Louis, Mo.



WEBSTER
Handling Equipment

Long experience in the design and application of material-handling equipment fits WEBSTER engineers to aid you in solving the problems of material-moving in your plant. Call upon them.

Man-power must be conserved in the modern plant. operations simplified, and production speeded. Webster equipment accomplishes these results because it is rightly designed.

Arrange to concentrate all your elevating, conveying, and transmission purchases with WEBSTER. Efficiency will be assured, with dependable service.

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1856 N. Kostner Ave., Chicago

Sales Offices:
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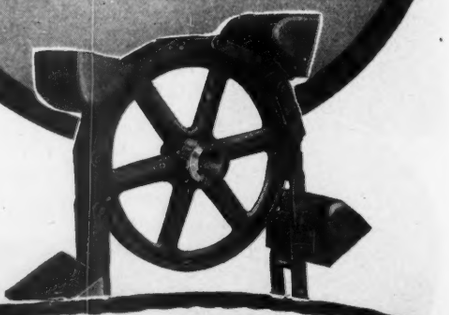
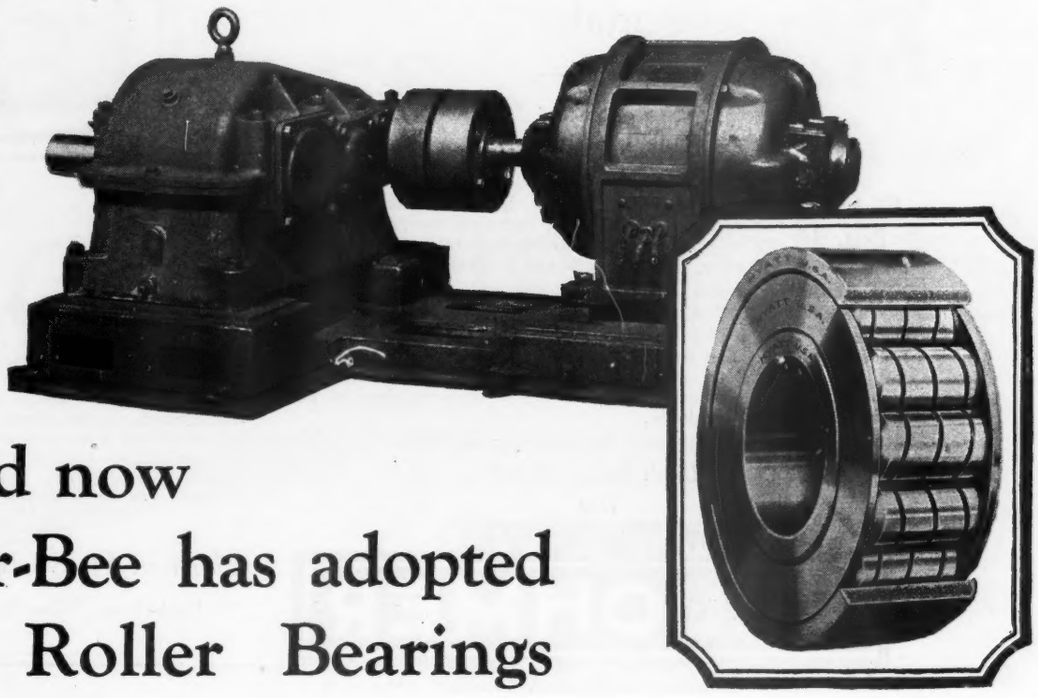


Some Webster Products

Conveyors (every type)	Elevator Buckets	Gears
Feeders	Skip Hoists	Bearings
Elevators	Sprockets	Hangers
	Chain	Car Pullers, etc.

Hyatts have served builders of speed reducing units for several years



. . . and now Palmer-Bee has adopted Hyatt Roller Bearings

LEADERS in industry, in many applications, have increasingly called on Hyatt Roller Bearings to assure frictionless, attentionless bearing performance.

Palmer-Bee is the latest of a long line of speed reducer builders to thus employ Hyatts.

Sturdy Hyatts take care of sudden shock loads . . . thev keep the gears in true alignment. Their smooth turning motion and freedom from wear assures long life to the equipment.

Ease of installation and their positive lubricating qualities have won for Hyatts a foremost position in speed reducer application.

Small wonder, then, that Hyatt bearings continue to serve all industrial equipment builders. Small wonder that Palmer-Bee, like many others, turns to Hyatt for lasting bearing satisfaction.

THE new Palmer-Bee Herringbone Speed Reducers, built by Palmer-Bee Company, Detroit, Mich., are equipped with Hyatts on the intermediate shafts.

The principal manufacturers of speed reducers throughout this country and Canada are in a position to furnish their equipment with Hyatt Roller Bearings as either standard or optional, and complete or in part. Specify Hyatts on your next order. We will gladly send the names of Hyatt users to any who are interested.

HYATT ROLLER BEARING COMPANY

Newark Detroit Chicago Pittsburgh Oakland

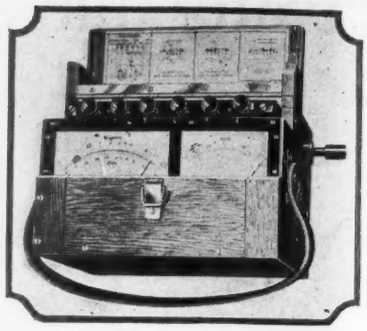
HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

Systematic insulation resistance tests make possible—

large economies!



EXAMPLE No. 3* In the coal mine where there's no substitute for dependable operation of electrical equipment, Sticht 2 in 1 Megohmers have helped raise safety standards and at the same time brought about substantial economies. New transformers, new and re-laid cables, repaired and new motors are carefully tested and checked before power is applied.

On one occasion a 5 hp. motor had been unhooked for rewinding. But a Megohmer Test made it unnecessary. Instead of a rewinding job costing about fifty dollars plus the loss of the motor's service, only a blow-out and a paint spray were required to put motor in first class condition.

*Nielsen Certified Performance Survey—copy on request.

Megohmize to economize!

By eliminating unnecessary repairs, Sticht 2 in 1 Megohmers often save their first and last cost the first time they are used Here's a valuable essential unit for your testing which you should know more about. Let us tell you where you can use one to your advantage. Just write for illustrated booklet and data sheet. Sticht Engineers will offer cost-saving suggestions.

Don't Guess—Test!

Use

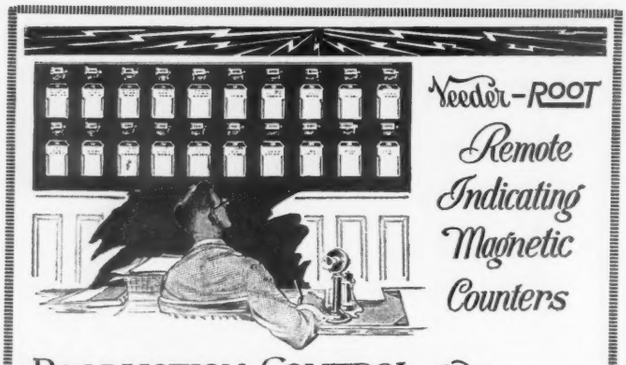
The "2 in 1"

MEGOHMER

TRADE *A Siemens & Halske Product* MARK

Herman H. Sticht & Co.

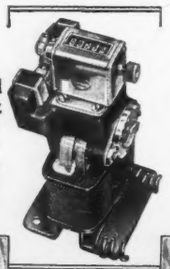
17 Park Row, New York, N. Y.



Veeder-Root

Remote Indicating Magnetic Counters

PRODUCTION CONTROL *from your Office*



You can watch and control machines in the shop without leaving your office chair. Glance up at the dials of Veeder-Root Counters, banked on a board over your desk. There, you read the production of any machine—any minute. The record, *in total*, of finished products or smallest parts.

Mechanical contacts on machines in the shop make and break the electrical circuits which operate the counters over your desk. Your regular lighting circuit supplies the current. Ask for *Booklet E 2.*

Veeder-Root INCORPORATED HARTFORD, CONN.

Pay Double Dividends

Records prove that Dayton Safety Ladders are far more economical than other ladders because they are scientifically designed and sturdily constructed to withstand the roughest usage. They pay for themselves many times over. The money they save through preventing accidents and speeding up work produces extra dividends that cost you nothing. Made in sizes 3 to 16 feet. Moderately priced.

Write Dept. IE-12 for complete information

DAYTON Safety Ladder

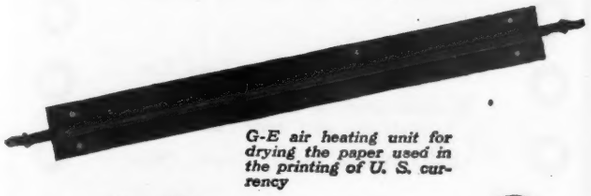
(Patented)

The Dayton Safety Ladder Co.

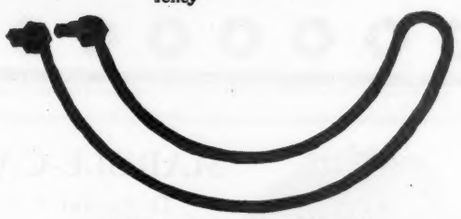
121-123 W. Third St. Cincinnati, O.

Stock carried by Pacific Coast Representative, E. D. Bullard Co., Los Angeles and San Francisco, and by 160 other distributors from Coast to Coast.

Dollars to Doughnuts



G-E air heating unit for drying the paper used in the printing of U. S. currency



G-E sheath wire immersion unit used in doughnut machine which fries 40 dozen doughnuts per hour

IT'S dollars to doughnuts that you can use electric heat somewhere in the manufacture of your products—and thereby improve them and effect worth-while savings.

A handful of heat, exactly placed, speeds and improves the manufacture of hundreds of products. G-E localized heating units provide this spot of heat just where it is needed; they give the exact temperature without attention; they improve working conditions; they require no piping, and are very easy to install. Thousands are in use. Complete information at your nearest G-E sales office.

Although electric heat will not supplant all other forms of heat for industrial purposes, there are processes in every industry where it is the ideal heat—the most economical heat—the heat that ultimately will be used.

ULTIMATELY
ELECTRIC HEAT
IN EVERY INDUSTRY

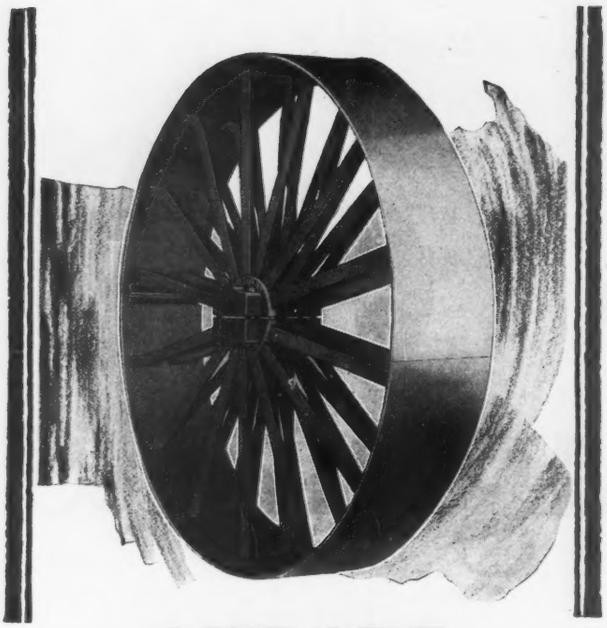
G-E localized heating units help in the manufacture of

Dollars	Labels
Automobiles	Macaroni
Bottle Caps	Newspapers
Cakes	Paper Boxes
Cereals	Porcelain
Chemicals	Pure Oil
Chewing Gum	Roofing Paper
Chocolate Bars	Rubber Stamps
Cigarettes	Shoes
Drinking Cups	Tin Cans
Hosiery	Doughnuts

570-3

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES



MEDART

HERCULES PULLEYS

A *Super-strong Pulley* that will take a walloping and "keep on smiling." Specially built to meet the most severe transmission conditions—heavy belt pulls, shock loads, strains, peak loads have no effects on Medart Hercules Pulleys. They "start where other pulleys stop."

If you are having trouble with your pulleys, write us and we will recommend the correct Hercules Pulley and build it specifically to meet your requirements—with a warranty that it will give entire satisfaction.

Medart Hercules Pulleys eliminate costly breakdowns and possible injury to workmen and assure greater economy and positive safety.

Built solid or split, in sizes from 16-inch to 192-inch diameter with belt face up to 50 inches.

GET CATALOG 43 WITH DISCOUNT SHEET FOR PRICING

For "Everything in Line Shafting Equipment" get Catalog 43 and Discount Sheet; also Bulletin on Medart Timken-equipped Line of Industrial Appliances.

THE MEDART COMPANY
(Formerly Medart Patent Pulley Co.)
General Offices and Works, St. Louis, U.S.A.
Offices in
Chicago • Philadelphia • Pittsburgh • New York • Seattle
Office and Warehouse in Cincinnati

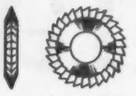
DRIVE RIGHT
POWER TRANSMISSION ASSOCIATION

MEDART
Everything in Line Shafting Equipment

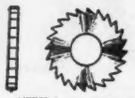
HULLHORST

Mica Cutters

Cut smooth grooves at lowest cost



"V" type cutter



"U" type cutter

The "cost of undercutting per commutator" depends upon the life of cutters—not on the "cost per cutter." From this viewpoint, Hullhorst mica cutters are the most economical.

Supplied in all sizes—in small or large quantities. Uniform quality guaranteed. Write for prices—mention size and type of cutters used.

The Hullhorst Micro Tool Co.

Manufacturers of mica undercutting machines and mica cutters

3242D Monroe Street, Toledo, Ohio

MARBLE-CARD

D. C. and A. C.

MOTORS

Require only a minimum of servicing. Have unusually long life. Help maintain maximum production.

D. C. Machines up to 75 H.P. with commutating poles. Get Bulletin No. 200.

A.C. Machines up to 75 H.P. All standard speeds and voltages. Get Bulletin No. 300.

Built to a Standard

Marble-Card Electric Company
Gladstone, Michigan

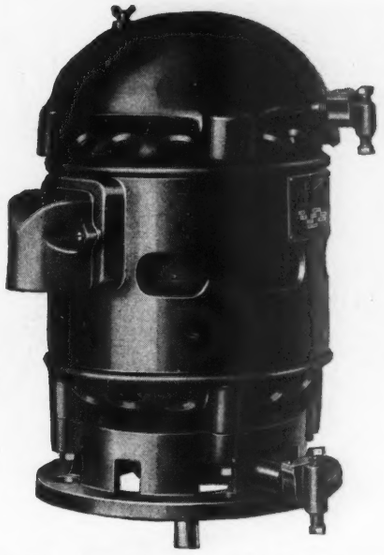
Ball Bearing Portable Blower

Order one on 10 days' free trial.

6½-lb. Air Cooled Ball Bearing Motor $45.00 Net.

REDUCE your FIRE HAZARD and MOTOR TROUBLES by the frequent use of this "MARVEL" Portable Dust Blower, which gives a continuous blast of DRY air, for blowing inflammable dust out of your MOTORS and other machinery.
Ask us to ship you one on 10 DAYS' TRIAL.

Manufactured by
ELECTRIC BLOWER COMPANY
352 Atlantic Avenue, Boston 9, Mass., U.S.A.



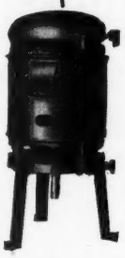
1½ Horse Power Century Type SC Vertical Squirrel Cage Induction 3 and 2 Phase Motor

Vertical Motors

Century Type SC Vertical Squirrel Cage Induction 3 and 2 Phase Motors are built for either ring or tripod mounting. The mountings are interchangeable on the motor...The ring-mounted motor is especially desirable where compactness is necessary....The tripod-mounted motor permits accessibility to the shaft, packing glands, etc., of the driven apparatus.

These motors are regularly equipped with ball bearings and oil lubrication....Their desirable operating characteristics and physical adaptability make them especially suitable for agitators, extractors, sump pumps and similar apparatus.

Built in standard sizes from ½ to 200 horse power.



The armatures of Century Type SC Vertical Squirrel Cage Induction 3 and 2 Phase Motors are practically indestructible.

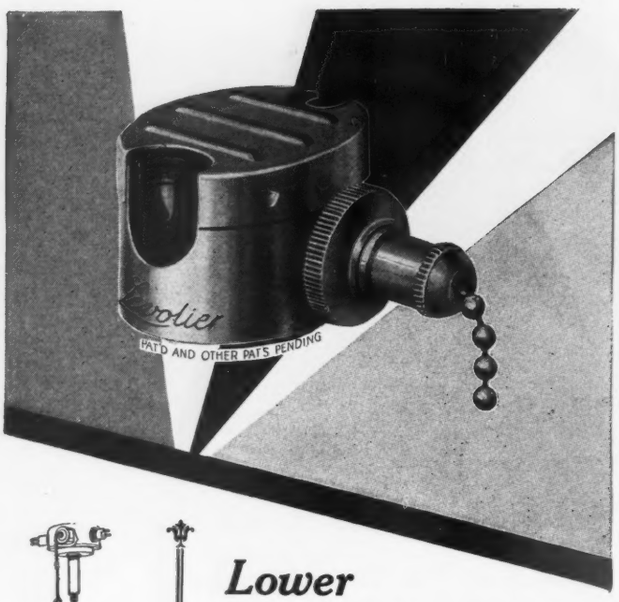
CENTURY ELECTRIC COMPANY

1806 Pine St. St. Louis, Mo.

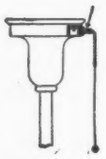
35 Stock Points in the United States and More Than 50 Outside Thereof

Century MOTORS

"THEY KEEP A-RUNNING"



Used in Knockout of Conduit Box



Ideal for Canopies

Fit Shallow Ceiling Pans

Canopies of Store and Office Fixtures

Lower Production Costs This Easy Way

In modern plant lighting great stress is played on the importance of the big lamp units, not only because of greater illumination but because of decreased spoilage, reduced accidents, improved quality of the product, and lessened labor turnover. With the big lamp units, however, the need for individual control is evident.

the New *Levolier* Fixture Switch

effectively controls each lamp individually. It is simple, self-contained, easily installed, and away from the heat of the lamp. It will stand the wear and tear of the hardest service—even the initial smash of switching a cold 500-watt gas-filled Mazda lamp.

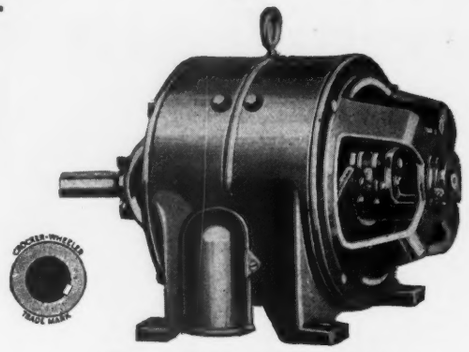
Let us send you a sample and full information.

Levolier
Pull Sockets
Pull Hooks
Conduit Box
Fixture, Lever, Pull and In-Between Switches
Hickeys

McGILL MANUFACTURING CO.
Electrical Specialties of Quality
ESTABLISHED 1904
VALPARAISO · INDIANA

Lamp Guards
Lamp Coloring and Frosting
Soldering Flux
Blow Torches
Lamp Changers

It took 40 years...



...to build this Motor

Back of the building of the new type F Crocker-Wheeler direct current motor are forty years of experience; forty years of intensive laboratory research; forty years of practical motor construction; forty years of study of general purpose motor uses.

The result is a motor that we are proud to put our trademark on; that you will be satisfied to use.

Descriptive bulletin sent on request.

Crocker-Wheeler Electric Mfg. Co.
Ampere, New Jersey

Birmingham · Boston · Buffalo · Chicago
Cleveland · Detroit · Denver · Houston
New York · Philadelphia · Pittsburgh · San Francisco

CROCKER-WHEELER

ROWAN CONTROL
THE ROWAN CONTROLLER CO., BALTIMORE, MD.

A Heavy Duty Push Button—

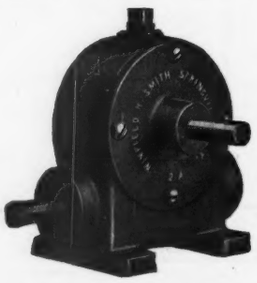
TYPE 6150
PUSH BUTTON

Oil-Immersed
Vapor-Proof
Moisture-Proof
and Dust-Tight—

Used either with or without oil.

SPEED REDUCERS

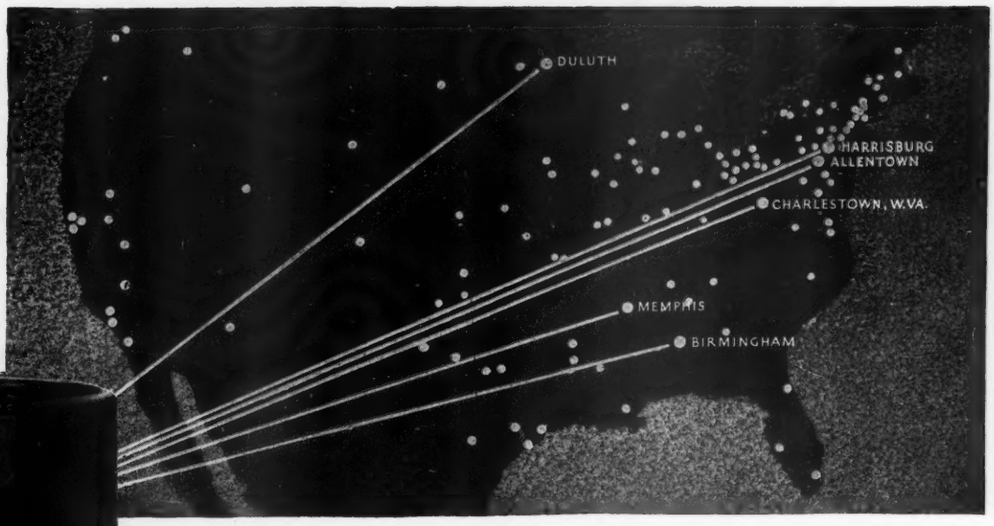
In Stock for Immediate Shipment

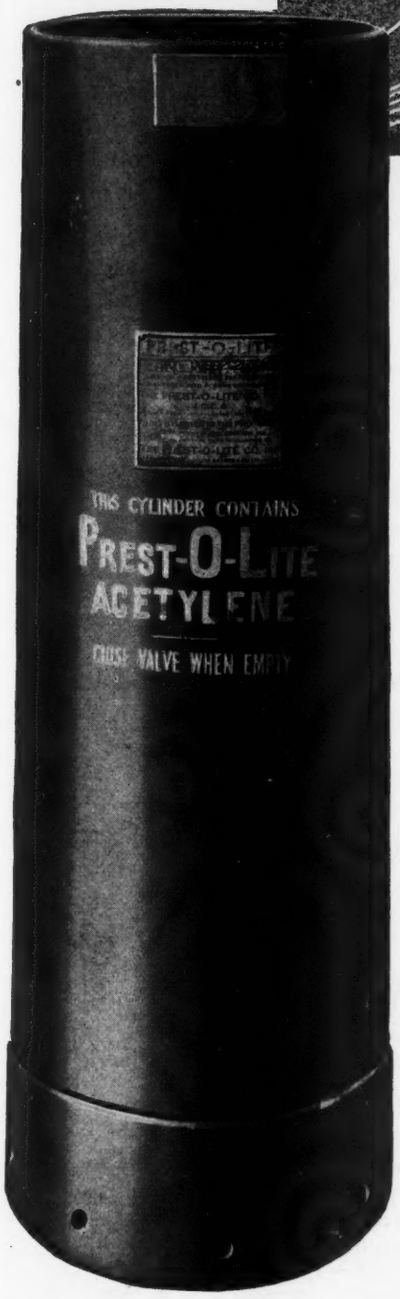


For Motors up to 5 H.P. Capacity

Catalog on Request.

WINFIELD H. SMITH, Inc.
15 Eaton St., Springville, Erie Co., N. Y.





Six new reasons for buying

Prest-O-Lite

DISSOLVED ACETYLENE

THE FACT that Prest-O-Lite could be readily obtained direct from plants or warehouses in most of the industrial centers of the country has been one reason for its tremendous success.

But the nation-wide demand has been steadily growing. To keep pace with this increased business, six new manufacturing plants have been placed in operation during the past year.

And now, with a total of 35 plants and 100 warehouses, Prest-O-Lite is equipped to render industry even greater service.

THE PREST-O-LITE COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

GENERAL OFFICES: Carbide and Carbon Building
30 East 42d Street, New York

THE TEXAS COMPANY *says* in "Lubrication"

"Pressure lubrication is especially advantageous where either oil or grease may be used, inasmuch as it more generally insures that accumulation of dirt, caked lubricant or other foreign matter will be more completely flushed or forced out from clearance spaces and oiling grooves."

but you must have the right lubricating devices

It does not pay to guess. The best lubricant that money can buy is handicapped unless it is applied to bearings in the most efficient manner.

Right here is where DOT engineers step in with an offer of real assistance. Lubrication experts will come to your plant and make a careful "Case Study" of your requirements. Efficient lubrication hinges on team work; good lubricant and a scientific method of applying it.

The DOT line is complete, to give you the precise lubricating device you need. It includes:

DOT Guns and Nipples

DOT-o-Matic Pressure Cup

DOT Group Lubrication System

DOT Nozzle-Fil Gun and Filling Tank

DOT Electric Lubricator

DOT Little Giant Grease Pump

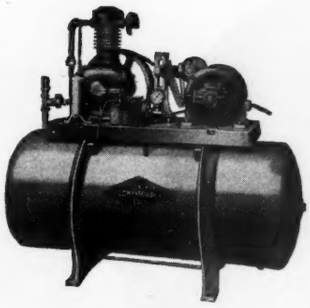
Write for the book, "Better Lubrication for All Machinery" —gratis, of course.

DOT LUBRICATING EQUIPMENT COMPANY
DIVISION OF CARR FASTENER COMPANY
26 Ames Street, Cambridge, Mass.

DOT REPRESENTATIVES ARE LOCATED IN PRINCIPAL CITIES

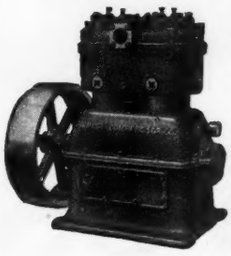
Atlanta	Chicago	Detroit	Minneapolis	Philadelphia	San Francisco
Baltimore	Cincinnati	Duluth	New Haven	Pittsburgh	Seattle
Birmingham	Cleveland	Los Angeles	New Orleans	Providence	St. Louis
Buffalo	Dallas	Milwaukee	New York	Richmond	Syracuse

DOT POSITIVE LUBRICATING EQUIPMENT COMPLETE



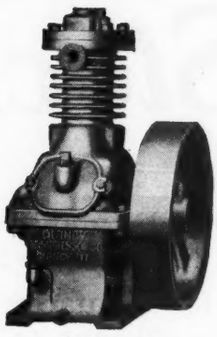
Model F-2

1½ H. P., 7 cu. ft. displacement, 150 lbs. pressure, or 2 H. P., 8.6 cu. ft., 150 lbs.; tank 20 in. x 48 in. An automatic all 'round air cooled unit.



Type W

Single stage water cooled compressor in 4 sizes, 4½ x 4 in. to 6¼ x 5 in. single and duplex. Displacements up to 124 cu. ft.



Model A

A-0	1⅝ x 1½	1.4 cu. ft.
A-1	2½ x 2½	4.2 cu. ft.
A-2	3 x 3½	8.6 cu. ft.
A-3	4½ x 3½	19.2 cu. ft.
A-4	4½ x 4	22. cu. ft.
A-5	4½ x 5	27.6 cu. ft.

Model A furnished with tight and loose pulley if desired.

Exceptional Precision

Exceptional Power

Mechanical precision in most of your factory equipment is vitally important. But it is *particularly* important in your air power units.

Mechanical precision has been carried to the ultimate in Quincy Compressors. Add this to their perfect design and rugged build, and you have compressors that measure right up to your highest expectations. They give the kind of service you want—and the kind you have every right to expect of a high grade compressor.

There is a wide range of types and sizes—air and water cooled. One of these is exactly right for your needs—whether they be for paint spraying or sand blasting, the operation of pneumatic tools and hoists, pumping water and chemicals or "blowing" a forge.

The coupon will bring a catalog of illustrations and specifications. Send for it.

QUINCY COMPRESSOR CO.
212 Maine St., Quincy, Ill.

Please send me the complete story of Quincy Compressors as applied to my individual business.

Now using compressed air for .....
Could use compressed air for .....
Firm Name .....
Line of Business .....
Address .....
City ..... *State* .....

QUINCY COMPRESSOR CO.

Quincy Illinois

MR 281

SERVICE AND SALES OFFICES

Atlanta, Ga. Chicago, Ill. Cincinnati, O. Dallas, Tex. Detroit, Mich. Houston, Tex. Kansas City, Mo. Moline, Ill. New Orleans, La. Oklahoma City, Okla. St. Louis, Mo. Washington, D. C.

Also in other important centers

1924~10 H.P. Drives *from Stock*

1926 15 H.P. Drives *from Stock*

Flexible as a Belt—
Positive as a Gear—
More Efficient than Either.
(98.2% on actual test)

and today ½ H.P. to 60 H.P. Drives *from Stock!*

THE convenience enjoyed by industry through the Link-Belt "Stock Drive" policy inaugurated four years ago, has now been greatly augmented.

The demand for Link-Belt Silent Chain Drives has been increasing so rapidly that now they can be obtained from Link-Belt stocks, or from distributors throughout the United States, in sizes from ½ H. P. to 60 H. P., and in speed ratios of 1 to 1 up to 7 to 1.

Recognized for a quarter of a century as the efficient, economical power transmitter, Link-Belt Silent Chain still upholds its reputation in every industry the world over as "*the ideal drive.*"

Get your copy of the new Pink List No. 725, from your distributor or nearest Link-Belt office.

LINK-BELT COMPANY 3583

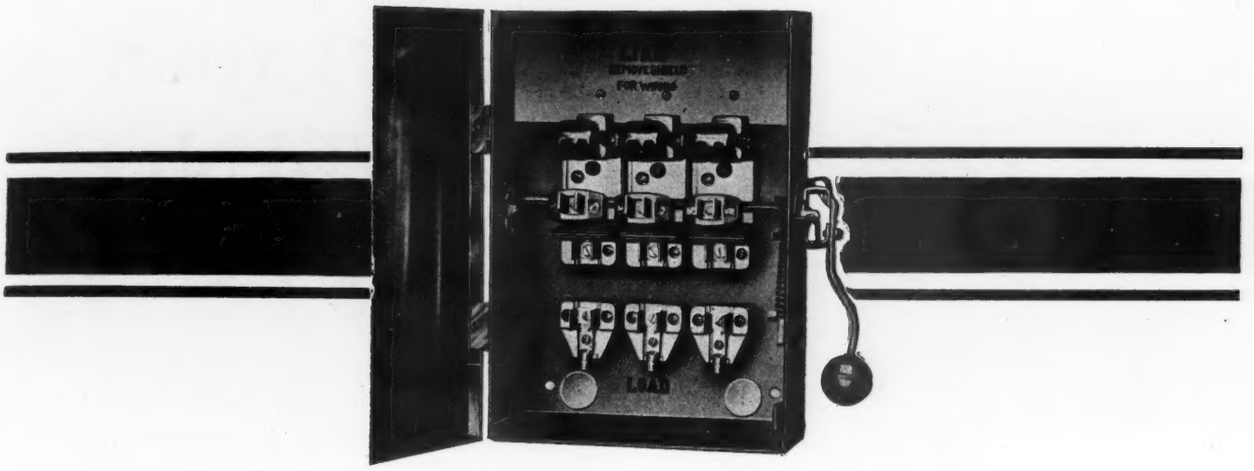
Leading Manufacturers of Elevating, Conveying, and Power Transmission Chains and Machinery

CHICAGO, 300 W. Pershing Rd. INDIANAPOLIS, P. O. Box 85. PHILADELPHIA, 2045 W. Hunting Park Ave. SAN FRANCISCO, 19th and Harrison Sts.

Ashland, Ky.	Birmingham	Charlotte	Dallas	Huntington, W.Va.	Louisville	Montreal	Oakland	Seattle	Toronto
Atlanta	Boston	Cincinnati	Denver	Kansas City, Mo.	Milwaukee	New Orleans	Pittsburgh	St. Louis	Utica, N. Y.
Baltimore	Buffalo	Cleveland	Detroit	Los Angeles	Minneapolis	New York	Portland, Ore.		Wilkes-Barre

LINK-BELT SILENT CHAIN DRIVES

Plant Engineers, HERE IT IS!



—the SUPER INDUSTRIAL Safety Switch

Have you ever had a safety switch blow up on the job?

Have you ever had a safety switch fail at an inconvenient time?

If you have, you have probably cussed the delay in plant operation. All this is costly.

Here's the remedy.

This T-V Current Breaker is built to break better than the *full* rated load. Not only that, its construction is such that you can use it on the toughest job you can pick out and it will stand up.

Now then, look over your plant, select the place for this switch to be tried, and send the coupon below. We'll do the rest. There is no obligation. This is the greatest industrial safety switch of the times. If a greater is needed, we'll build it.

Important—Send Coupon and describe conditions now existing.

Trumbull-Vanderpoel Elec. Mfg. Co.
BANTAM, CONN.
Pittsburgh New York St. Louis Chicago Philadelphia Atlanta Boston Denver
On the Pacific Coast—C. Dent Slaughter

T-V SAFETY SWITCHES

Send this in now

Trumbull-Vanderpoel Elec. Mfg. Co.
We'd like to be convinced.

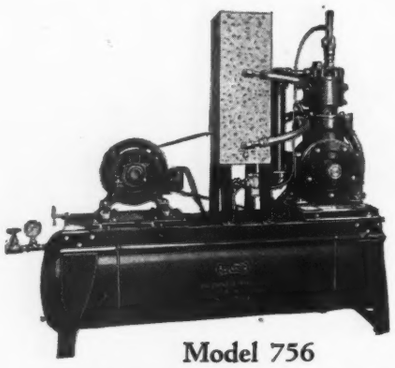
Firm .....
Address .....
Name .....
Title.....

Am sending herewith full details of job we would like remedied.
(Describe fully conditions to be met.)

BRUNNER EQUIPMENT

WILL CUT YOUR PAINTING COSTS

Model 300
Spray Gun



Model 756

Completely assembled outfits in sizes to operate one to five guns.

Brunner No. 2 Spray Combination

1—300 A Gun
1—Cup
1—Air Conditioner
1—3 gal. Pressure Feed Container
2—25 ft. Lengths Air Hose and Connections.
30 ft. Metal Lined Hose.

Brunner Equipment will lower your painting costs whether on the production line, or in the maintenance, construction or repair department.

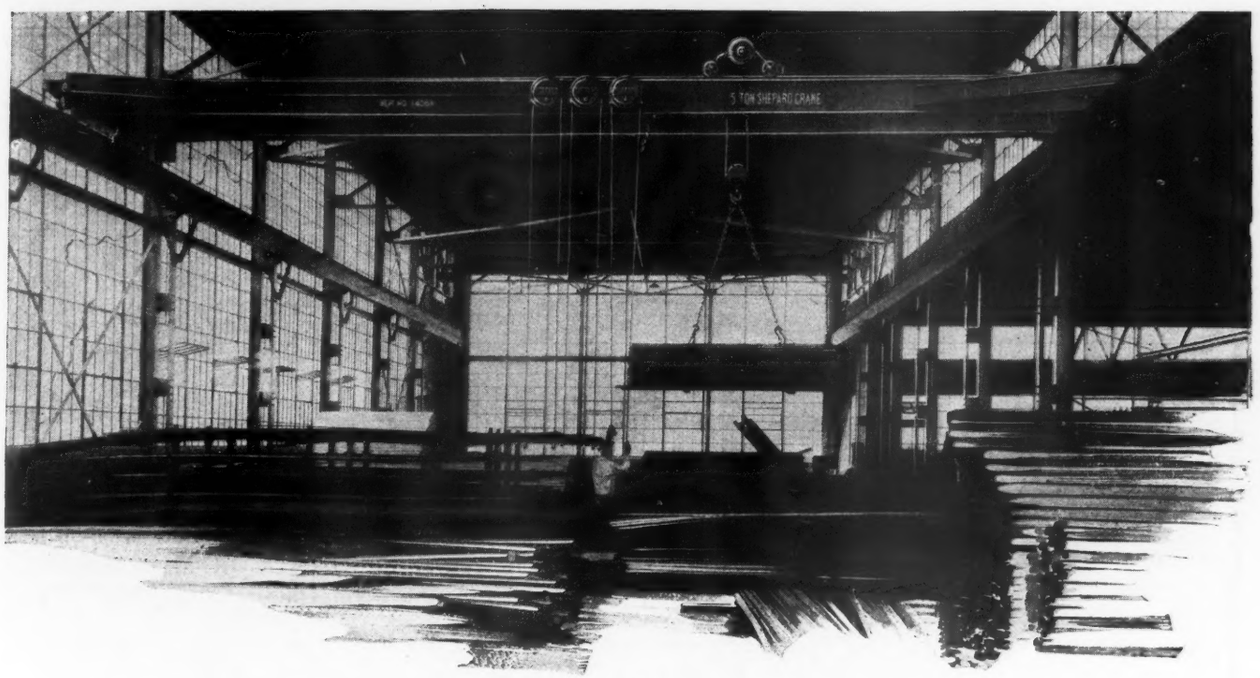
Practically all paint material, from lacquer to heavy asphaltum paints, can be effectively applied by the Brunner Spray method to any type of surface.

The model 300 Brunner Spray Gun will apply paint from three to six times faster than the hand brush and will reach the most inaccessible places. The Brunner method insures complete paint coverage and produces better paint jobs.

Brunner Equipment is furnished in sizes and models, either stationary or portable, for every requirement. Let us send you catalog 23-A describing the complete Spray Painting line.

BRUNNER MFG. COMPANY
UTICA, N. Y.

BRUNNER Spray Paint Equipment



Now 2 men handle all raw materials *with a Compact Crane*

Planned load handling has banished a costly time consuming job for the Anchor Post Fence Company. At their new Baltimore plant, a 5 ton Shepard Compact Crane handles the thousands of tons of steel bars, wire, angle iron and other raw materials used in making Anchor Fences. The labor force has been reduced to two men—the operator and an assistant.

Savings are effected in runway and building construction—the crane gets closer to the walls—material can be stacked in higher piles—and greater speed in all travel motions has been effected. These advantages are directly attributable to the Shepard standardized design and all-steel unit construction.

A Compact Crane is unburdened of excessive structural weight. It has strength and stamina in abundance to withstand the rigors of the severest service. It provides a "special job" crane at a quantity production price.

Let us give you complete information about the Compact Crane. A letter will bring the nearest Shepard representative.

In the finished material storage a Shepard Electric Hoist on an I-Beam Crane speeds handling of the 500 lb. rolls of wire netting.

SHEPARD ELECTRIC CRANE & HOIST CO.
415 Schuyler Ave., Montour Falls, N. Y.
Branches in Principal Cities

SHEPARD
ELECTRIC CRANES & HOISTS
Largest Manufacturer of Electric Hoists in America

Member Electric Hoist Manufacturers Association.

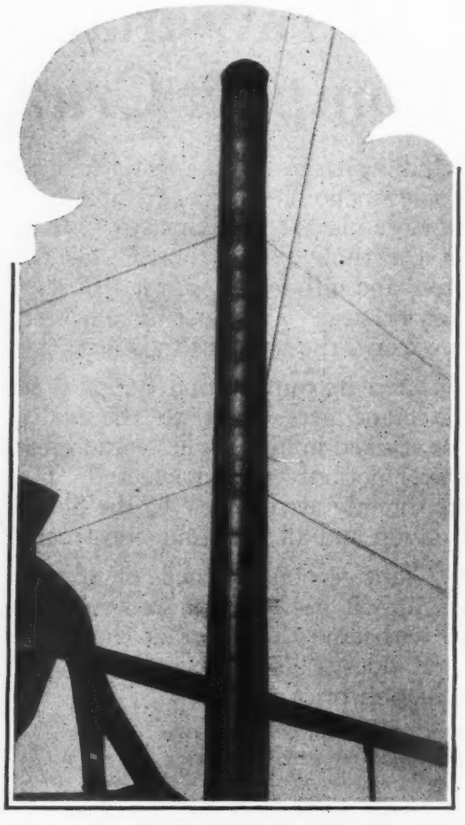
". . . unusually good service from a stack"

An Experience of the Norwood Sash & Door Manufacturing Company with an ARMCO Ingot Iron Stack

"Our ARMCO Ingot Iron smoke stack recently dismantled was found to be in such excellent condition that we believe you will be interested to know that it has been in continuous service since September, 1912.

"You will realize, of course, that since we burn from fifty to seventy-five per cent waste wood, this is unusually good service from a stack. The stack was still in good condition and we would not have had to take it down had it not been for the fact that we were putting in a new power plant which called for a smaller stack."

THE NORWOOD SASH & DOOR MFG. CO.
Norwood, Ohio



Burning wood—rust fire* intensified! Yet ARMCO Ingot Iron withstood this relentless attack for twelve years and was still good when removed to make way for a smaller stack.

The high and uniform purity of ARMCO Ingot Iron made this typical service possible . . . Electrolytic corrosion can not gain rapid headway in "pure iron" as it does in less pure irons and steels.

Your company, too, can lower that rust-fire toll with ARMCO Ingot Iron. Ask our consulting engineers to show you the way—whether it's a stack, breeching, or any other installation requiring rust-resisting sheets and plates.

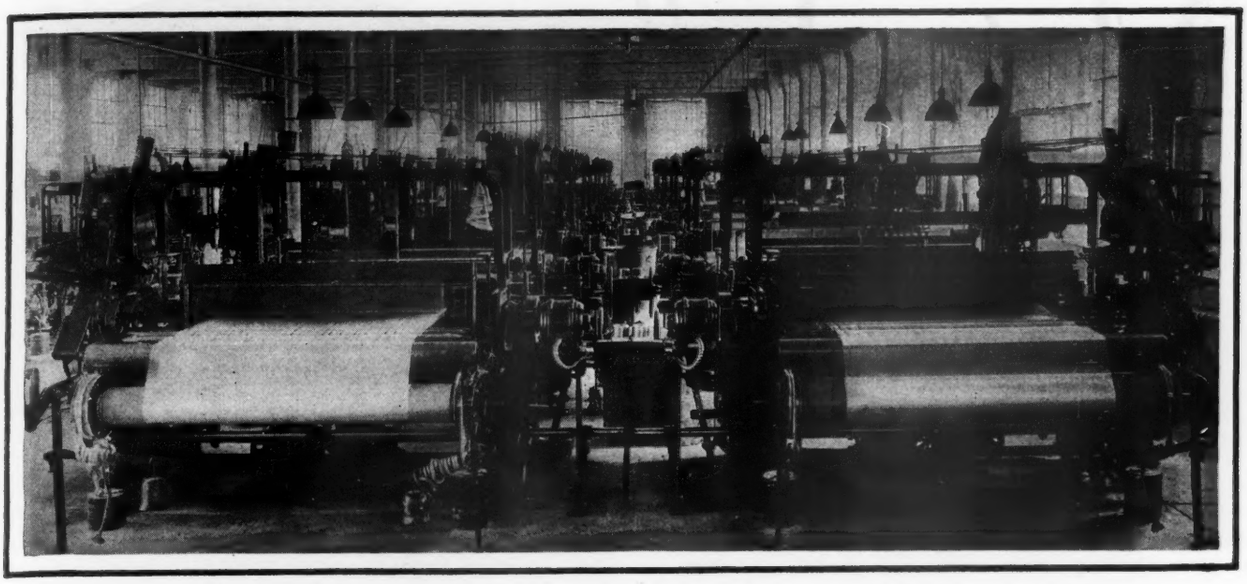
THE AMERICAN ROLLING MILL CO.
Executive Offices, Middletown, Ohio
Export: The ARMCO International Corporation
Cable Address—ARMCO, Middletown, (O.)

District Offices

Chicago	Detroit	New York
Cincinnati	Philadelphia	San Francisco
Cleveland	Pittsburgh	St. Louis

ARMCO
INGOT IRON
RESISTS RUST

* *The only difference between rusting and burning is time—both are oxidation. You can feel and see the fire produced by rapid burning. But when metal rusts, the process is too slow to see. Rust is the result of this fire.*



Protecting 800 Motors

One manufacturer has 800 a-c. and d-c. motors. He keeps them on the job, at a 50% decrease in servicing costs, by using G-E No. 880 protective paint. ¶Protection of motor parts is but one application of G-E No. 880 paint. It tightly seals oil cups, drain plugs, and pipe joints in gas, oil, and water systems. Wherever a resistant to acid, alkali, oil, water, or arcs is needed, G-E No. 880 will give lasting protection. ¶This paint does not blister or burn easily. Its hard, smooth, glossy finish shows the presence of carbon dust at once. It can be scraped and cleaned without injury, and will not crack or peel. ¶G-E No. 880 red protective paint, developed in General Electric laboratories, is extensively used in General Electric products. We can offer no stronger proof of our confidence in its value.

PROMPT SERVICE

G-E insulating materials are sold only by G-E Merchandise Distributors located throughout the country, who are equipped to give you prompt service. Get in touch with the G-E Merchandise Distributor near you or write to the Merchandise Department, General Electric Company, Bridgeport, Connecticut.

This catalog contains a complete listing of the following G-E insulating materials:

- Insulating and finishing varnishes
- Insulating oils
- Stickers
- Shellacs and paints
- Filling and sealing compounds
- Varnish-treated cloths and cloth tapes
- Flexible varnished tubing
- Insulating fibers and papers
- Motor tubing
- Asbestos and cotton tapes
- Friction and rubber tapes
- Prepared paper tapes
- Cords
- Twines

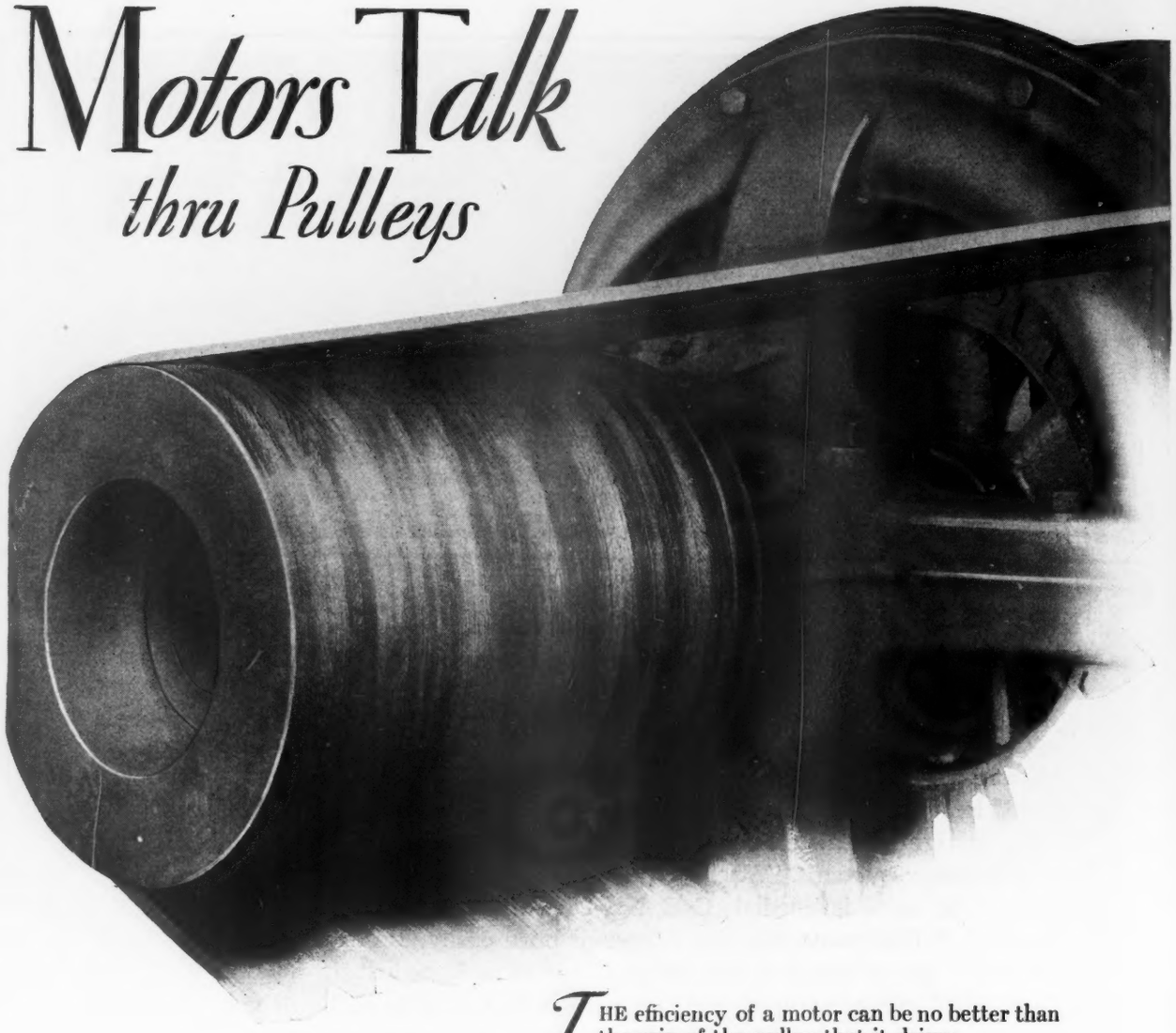
Send for your copy to the Merchandise Department, General Electric Company, Bridgeport, Connecticut.

800-203

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

Motors Talk thru Pulleys



THE efficiency of a motor can be no better than the grip of the pulley that it drives.

Sprucolite pulleys are built of *Compressed Spruce* .... the pulley material having the greatest known coefficient of friction.* It is compressed 30 to 70 percent of the original volume into a dense fibrous substance. The finished pulley weighs only a fraction of paper, outwears it, withstands shock loads and runs true, preserving the crown and edges.

Sprucolite pulleys cost no more than the ordinary kind. The pulley costs but a small fraction of the motor. The motor is only as good as its pulley. Ergo .... it pays to use Sprucolite.

Motors may be ordered with Sprucolite Pulleys or without any so that you may equip with Sprucolite pulleys purchased from your own dealer.

For detailed information and price list address the Sprucolite Corporation .... 348 Franklin Ave., Bloomfield, N. J.

Sprucolite also manufactured and sold on the Pacific Coast by Pacific Compressed Spruce Products, Inc., Tacoma, Wash.

✣ ✣ ✣ ✣ ✣

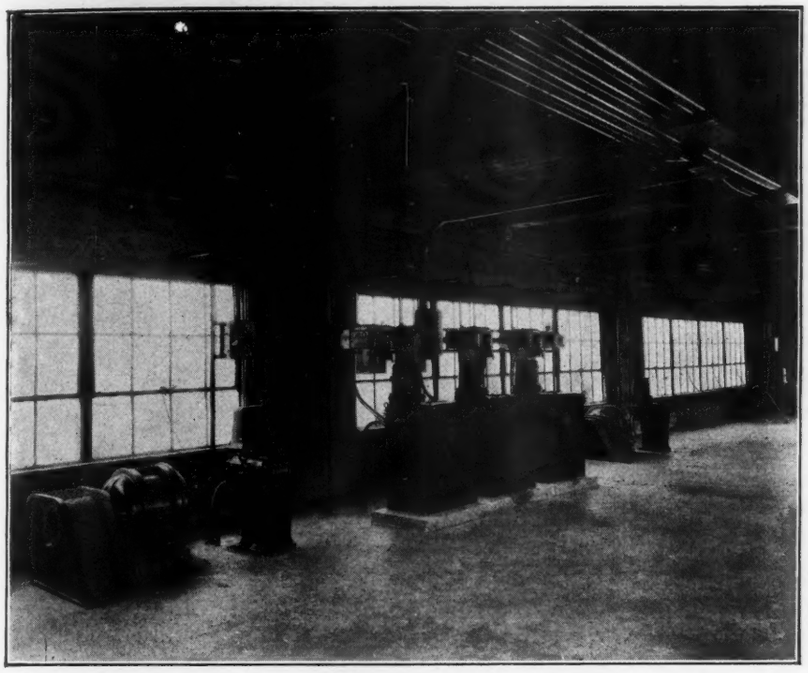
Sprucolite Pulleys for factory use are distributed exclusively through supply houses. Present dealers find them quick to sell, therefore profitable to handle. They tell us that general interest in them serves to make contacts for the dealers' salesmen that result in sales for other merchandise as well as in Sprucolite Pulleys. Let us send our dealer's proposition.

DRIVE RIGHT

POWER TRANSMISSION ASSOCIATION

COMPRESSED SPRUCE
SPRUCOLITE
BLOOMFIELD NEW JERSEY

*See data under Pulleys, Kent's Hand Book 1923, and thereafter. Better grip permits the use of closer centers.



The management of this plant selected EC&M Equipment because—

They couldn't afford a shut-down. EC&M Motor Starters guarantee continuity of service.

They wanted to start the motors from control stations at a distance from the motors. These EC&M Starters not only provide remote control but they also protect the motors against all abnormal conditions.

They recognized the economy in installing unit type EC&M Equipment as compared with the switchboard type.

They could safely install the 2300 volt EC&M Starting Equipment without having to build guards or special control rooms.

EC&M Starters make a neat installation job. This fact appealed to their pride in the appearance of the plant.

They have to combat dusts of an explosive nature. EC&M Oil-immersed Motor Starters are flame-proof.

These starters are described in Bulletins 1042-F & 1047

Low Voltage Automatic Compensator

High Voltage Automatic Compensator

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

NEW YORK-50 CHURCH ST. | CHICAGO-CONWAY BLDG. | DETROIT-DIME BANK BLDG. | BIRMINGHAM-BROWN-MARX BLDG. | CINCINNATI-1ST NATIONAL BANK BLDG.

HOUSTON-1006 WASHINGTON AVE. | LOS ANGELES-912 E. THIRD ST. | SALT LAKE CITY-228 SO. W. TEMPLE | TORONTO-REFORD BLDG.

PHILADELPHIA-WITHERSPOON BLDG. | PITTSBURGH-OLIVER BLDG. | SAN FRANCISCO-CALL BUILDING | MONTREAL-DRUMMOND BLDG. | TULSA-217 E. ARCHER ST.

Service shop facilities

G-E service only begins with the service shop. Back of all G-E Service Shops is the entire General Electric organization, upon which the shops may call when renewing electric apparatus.

Our laboratories not only invent processes and develop products, but also improve methods of repair and maintenance. Engineer specialists are ready to assist with service-shop problems. Complete repair information is available at all times. In each of our fifteen factories, a special production man makes sure that the required part for your equipment is promptly completed and shipped to the service shop.

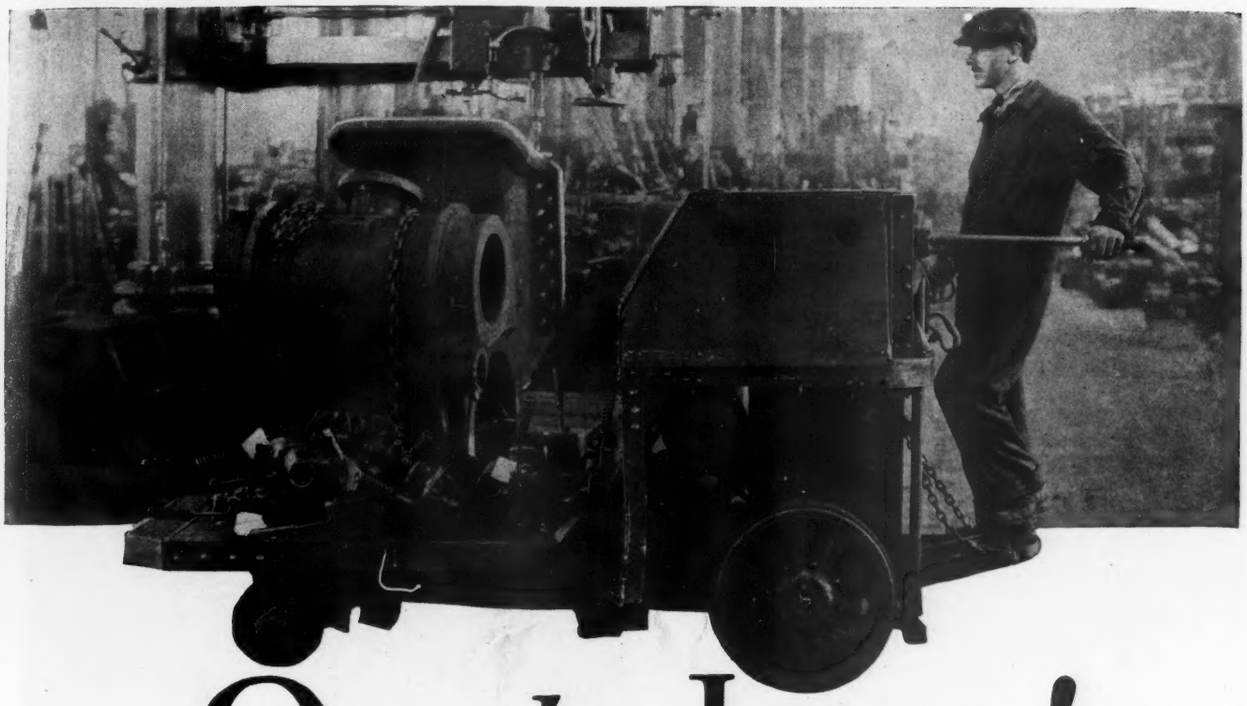
Every piece of General Electric equipment has behind it the services of a nation-wide organization of specialists and an unfailing source of renewal parts.

91-23

Wherever you may be located, when repairs are necessary, rail or truck will take your apparatus to a G-E Service Shop in a day. G-E Service Shops are located in the following cities:

Atlanta	Erie	Oakland
Buffalo	Fort Wayne	Philadelphia
Chicago	Kansas City	Pittsfield
Cincinnati	Los Angeles	Pittsburgh
Cleveland	Lynn	St. Louis
Dallas	Minneapolis	Salt Lake City
Detroit	New York	Schenectady
	Seattle	

GENERAL ELECTRIC



On the Jump!

...right up to quitting-time

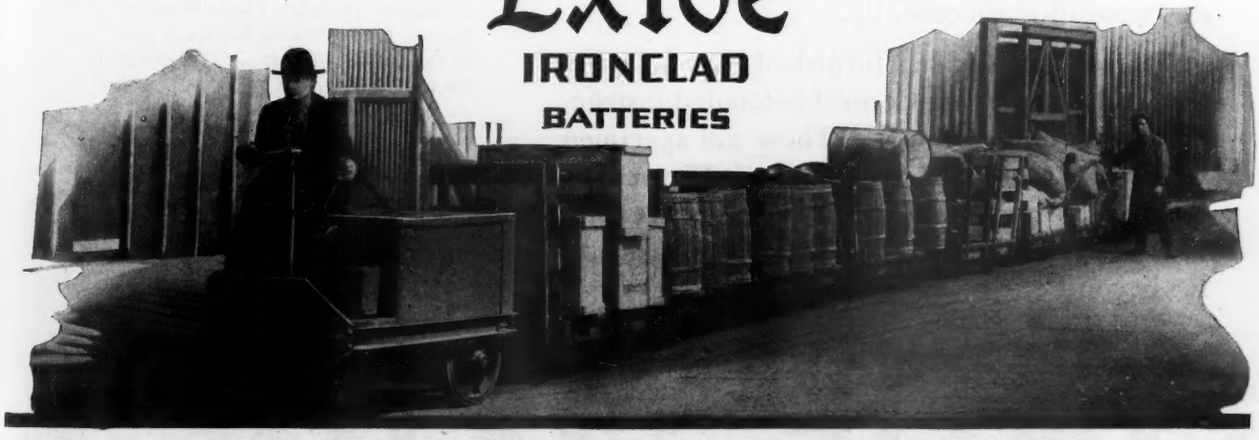
"LAST-HOUR" handling costs are as low as during the rest of the day when electric industrial trucks are powered with Exide-Ironclad Batteries. These batteries have a sustained speed that keeps electrics moving fast *right up to quitting-time.*

It's the voltage that does it. High voltage means good speed. And an Exide-Ironclad maintains a consistently high voltage *all day long.*

The Exide-Ironclad moves material quickly under *any hauling condition.* It has high power ability—a steady flow for level hauling, or a sudden rush of current to climb steep ramps or start heavy loads rolling.

This battery cuts costs at the charging panel, too. It takes in current quickly, easily and with little waste. And the Exide-Ironclad stays on the job for years. Its special positive plate construction gives it an unusually long active life. If you are interested in finding a way to move *more* material, faster and *cheaper* than ever before, ask any Exide-Ironclad user about this battery. We'll let his cost figures tell their own story.

Exide
IRONCLAD
BATTERIES



THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

Exide Batteries of Canada, Limited, Toronto

"Who is *that* man?"

"This is Mr. Robertson, Consulting Engineer of The Linde Air Products Company," said the Chief Engineer.

"When we found that our latest alloy required an entirely new procedure for welding, we called the Linde Company for help. They submitted the problem to their Research Laboratories, who have worked out a way to weld this new alloy successfully.

"Mr. Robertson has furnished us with what they call a Procedure Control—detailed instructions for doing the work. These are specimen welds made by their new method. We've just finished testing these coupons for tensile strength. Every one broke outside the weld at a figure far beyond our maximum requirements."

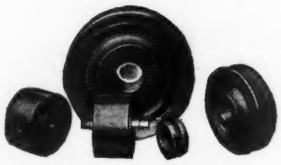
HUNDREDS of practical and theoretical problems involving the Oxy-Acetylene process are constantly being studied in the Union Carbide and Carbon Research Laboratories. The results of these studies as well as help on any special problems that may come up are available to Linde customers through Linde Process Service. Linde Process Service is one of the reasons that Linde Oxygen is the leader in its field.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide UCC *and Carbon Corporation*
General Offices: Carbide and Carbon Building
30 East 42d Street, New York
54 PLANTS · 98 WAREHOUSES

LINDE OXYGEN

Where there's Quality, there's Performance

"Tool Steel" Gear Performance records give ample evidence



Crane Wheels and Rollers

Gears—Spur, Helical, Solid, Split

Tool Steel Gears and Pinions have a soft but very tough center which gives them great strength. The wearing part is literally transformed to "Tool Steel" with a scleroscope hardness of 90 to 100.

The teeth take on a high polish and wear very slowly. Hence "Tool Steel" gears are lasting 8 to 10 times as long as the ordinary untreated steel gears under identical operating conditions.

Electric railway—Coal mining—Steel mill—Cement plant —Rubber mill—Crane gears and Crane wheels—any place with severe service.

Write for bulletin of proof.

The Tool Steel Gear & Pinion Co.
CINCINNATI, OHIO

SPECIALIZATION—that answers your question, "Why is 'MARING' the world's greatest value in magnet wire?" Continual research, experiments and development of special "MARING" Equipment have produced an unusual wire. "MARING" has effected economies, produced a better wire and delivered an operating service that would otherwise be unobtainable for magnet wire users.

Our highly developed facilities are available to you in the development and production of magnet wire to satisfy your specific requirements.

It costs you nothing to submit your particular magnet wire problem to us or one of our eight branch managers. Write us today. Learn the meaning of "MARING Service."

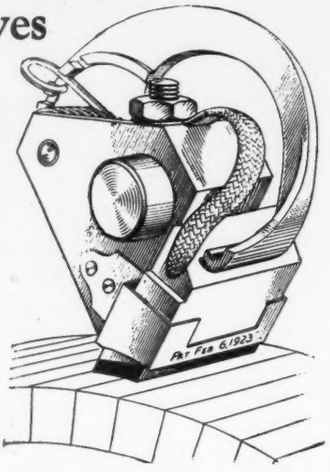
MARING WIRE COMPANY
MUSKEGON, MICHIGAN, U. S. A.

MARING
Magnet Wire

Rid your motor
of destructive sparking, hot commutators, noise and brush grooves

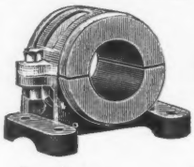
Equip with

Reaction Brush Holders
at our risk



Upon receipt of data for any machine you may wish to equip, we will furnish Reaction Brush Holder Equipment complete and ready to install, final acceptance being subject to satisfactory operation.

The Baylis Co.
50 Nelson St. Bloomfield, N. J.
Over 20 years in Service



FLETCHER SPECIALTIES
Insulator Supports made for DC and AC Current

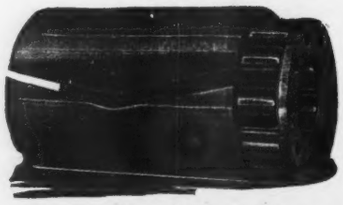
Insulator Supports

One piece Pole Shim

Catalog showing our full line mailed on application.

THE FLETCHER MFG. CO.
DAYTON, OHIO

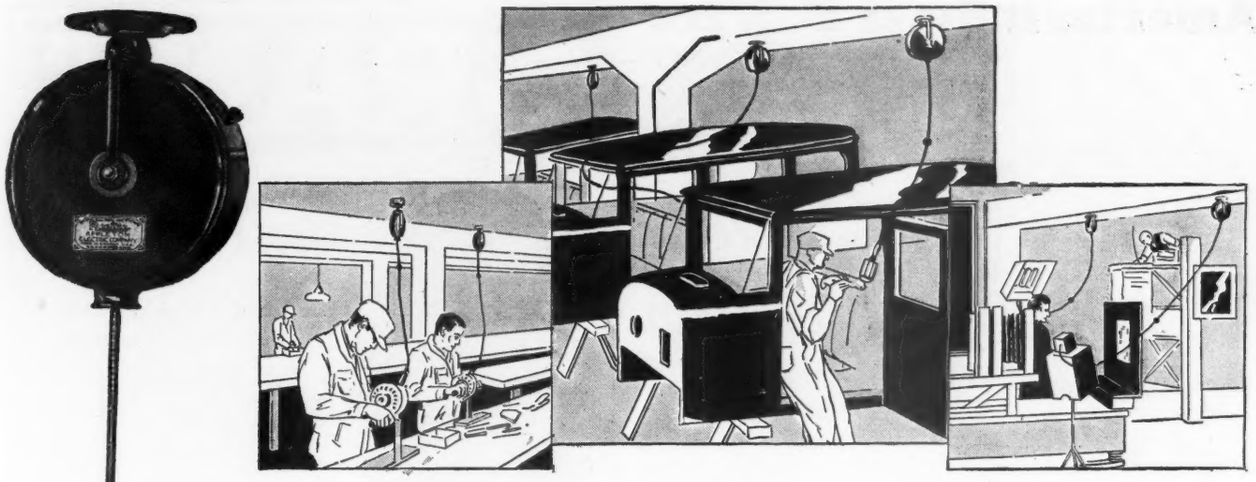
A Smaller Bearing for a Heavier Load



Rollers are machine tool steel—*solid*. This means greater load-carrying capacity.

All sizes carried in stock. **Liberal Discounts in Quantity.** Glad to tell you all about this bearing.

Royersford Foundry & Machine Co.
Royersford, Penna.



REELITE brings the light to the job!

EFFICIENT light directly on the job but out of your eyes . . . clear light that can be moved up and down at a touch . . . a portable light always on the job but never in the way—that's the Reelite.

While you work the light is convenient to your hand, focused on the job. The work done, you roll up the cord out of the way like a window shade, until you need it again. No damage can be done to the cord because it is never on the floor to be cut and frayed by sharp heels or moving trucks.

A Reelite can help you produce better work and cut down your cord renewals. There is a type and size to fill your exact requirements. Write for descriptive literature on either or both the Portable Reelite and the Constant Duty type. No obligation.

CONSTANT DUTY

Reelite

REG. U. S. PAT. OFF.

Carries current where needed

For supplying power-current to moving machinery, such as traveling cranes, lifting magnets, boring mills, portable hoists and mobile transfer cars. It is made in several types and sizes, suitable for all needs

APPLETON ELECTRIC COMPANY

1718 Wellington Avenue, Chicago, U. S. A.

New York—150 Varick St. Los Angeles—340 Azusa St.
San Francisco—655 Minna St. Seattle—628 Railroad Ave.

Reelite

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The Handy Light on a Reel

SEE OUR CATALOGUE IN SWEETS

American Steel & Wire Company

Graham, Anderson, Probst & White, Chicago—*Architects*
John Gill & Sons, Cleveland—*General Contractors*
Hatfield Electric Co., Chicago—*Electrical Contractors*

The TERMINAL TOWER Building
Cleveland, Ohio

Wired with

ASW 30% Wire

The new Cleveland Terminal Tower Building just opening its doors to serve the traveling public, adds another great testimonial, to the quality and service of ASW 30% Wire, with which it is wired.

It is becoming more generally conceded by engineers every day that specifying American Steel & Wire Company Wire is the best insurance of a dependable and lasting wiring system—and on every hand you see the increasing use of this wire in America's great new buildings.

Let us send you our indexed catalogue and handbook of electrical wires and cables. Estimates furnished promptly from any of our offices in all the principal cities.

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		WORCESTER	94 Grove Street
ST. LOUIS	506 Olive Street	BALTIMORE	32 So. Charles St.
KANSAS CITY	417 Grand Avenue	BUFFALO	670 Ellicott Street
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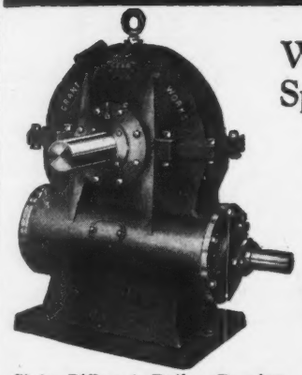
GRANT



Sixty Different Ratios Ranging from 3¾ to 1 up to 106 to 1

Worm Gear Speed Reducers

Speed Reducers in stock—for immediate shipment.

Three different types and five standard sizes. Sixty different ratios of from 3¾ to 1 up to 106 to 1, 120 hp. to 25 hp. Complete Grant catalog upon request.

GRANT GEAR WORKS

Makers of Good Gears Since 1877
B and SECOND STREETS, BOSTON, MASS.

GEARS

In one second! *and for years*

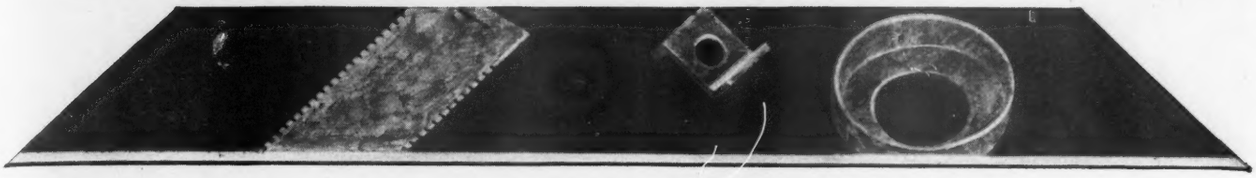
YOU can start a Zobell Torque Motor—do work and bring it to a stop—all in one second! And you can repeat the operation thousands of times with the same measure of reliability. Or you can apply Zobell high torque motors to heavy duty service such as cranes, hoists, switches, valves, etc. and obtain reliable service day in and out, for years. We have standardized on a line of high torque motors which take special shaft extensions readily—stand up in service and yet sell in quantities at prices comparable with commercial lines.

Let us figure on your hardest motor application.

The more special it is—the better.

ZOBELL HIGH TORQUE MOTORS

ZOBELL ELECTRIC MOTOR CORPORATION
GARWOOD, NEW JERSEY. 3004



Moulded and stamped with micrometer accuracy in any size and shape

MICANITE the original pasted mica insulation, is being made in thousands of sizes and shapes, to suit as many varying needs of the electrical industry. For motors, generators, control apparatus, instruments, electrical heaters, radio, etc., Micanite offers outstanding electrical, physical and chemical characteristics.

Micanite possesses high dielectric strength and is readily moulded or stamped to any desired form. An accuracy of 1/1000 of an inch for all dimensions is readily obtained in this age-resisting electrical insulation.

From mine to finished product—including the making of moulds and designing of dies—every step is controlled by our experts who place the experience of more than 35 years at your service.

Samples of Micanite in many varied shapes are freely offered for your inspection. A letter will receive our immediate attention.

MICA INSULATOR COMPANY

New York: 200 Varick St. Chicago: 542 So. Dearborn St.
Cleveland Pittsburgh Cincinnati San Francisco
Los Angeles Seattle Montreal Toronto, Canada
Works: Schenectady, N. Y. London, England

PERFECT MICANITE INSULATOR REG. U.S. PAT. OFF.

Electrical INSULATION

PERFECT EMPIRE INSULATOR REG. U.S. PAT. OFF.

MICA INSULATION OILED CLOTH INSULATION

De Laval Worm Gear

A Superior Speed Reducer for driving heavy machinery

THIS 50 to 1 ratio gear is transmitting 5 h.p. from a 690 r.p.m. motor to a 36 in. apron feeder in a copper smelting plant.

De Laval Steam Turbine Co., Trenton, N. J.

2998 AD-1012

EARLE GEARS

Let Earle cut your Gears and cut your costs

40,000 patterns from which almost any size and type of gear can be made, twenty-five years of experience, a modern plant equipped with machine tools of latest design, and skilled engineers and mechanics enable us to cut your costs by recommending gears to fit your conditions.

Every Earle Gear is made to your order and *delivered* when promised. Try Earle Service on your next RUSH order.

THE EARLE GEAR AND MACHINE CO
PHILADELPHIA, PENNSYLVANIA
95 Liberty St., N. Y. C. 110 State St., Boston, Mass.
P. O. Box 141, Plymouth, Pa.

HAISS

PORTABLE CONVEYORS and BUCKET LOADERS

for handling all kinds of bulk materials.

ALSO Bucket Elevators, Rotary Screens, Clamshell Buckets, Conveyor Systems, etc.

George HAISS Mfg. Co., Inc.
139th Street & Rider Avenue,
New York, N. Y.

The preferred babbitt

The choice of thousands of engineers because always uniform in composition, melts and pours well, and assures cool running, efficient and economical bearings.

Obtainable from your local dealer. Send for free booklet.

MAGNOLIA METAL CO., 75 WEST ST., NEW YORK

MAGNOLIA ANTI-FRICTION METAL

REG. U.S. PAT. OFF.

In the metal line, specify Magnolia Products

Pick your year to judge
C-H Auto Transformer Starters

"Built to the Standard of Millions of Operations"

—21 outstanding features

1 Magnet coil easily removed.

2 Double pull solenoid type magnet — quick positive pull.

3 Cushioned magnet construction assures long life.

4 Entire switch finger assembly easily removed as a unit.

5 New chimney type arc shields carry arc away from contacts to prevent pitting and burning.

6 Contacts easily removed for replacement or repair.

7 Individual switch fingers easily removed for replacement or repair.

8 Thermal overload relays cuts motor from line only when temperature of windings becomes dangerous.

9 Thermal overload adjustment accurate to allow for maximum loading without danger to motor.

10 Thermal overload heater coils easily changed to make each starter suitable for wide range of motors.

11 Overload release easily reset from outside of case.

12 Entire mechanism complete on unit panel is supported by mounting straps —not by case.

13 Quick-reset, adjustable timing device gives accurate, consistent timing.

14 Split case design allows easy access to all parts of starter mechanism.

15 Heavy duty blow-out coils quickly snuff arc to protect contacts.

16 Ample capacity transformer has easily accessible taps to regulate starting current to 50%, 65% or 80% normal.

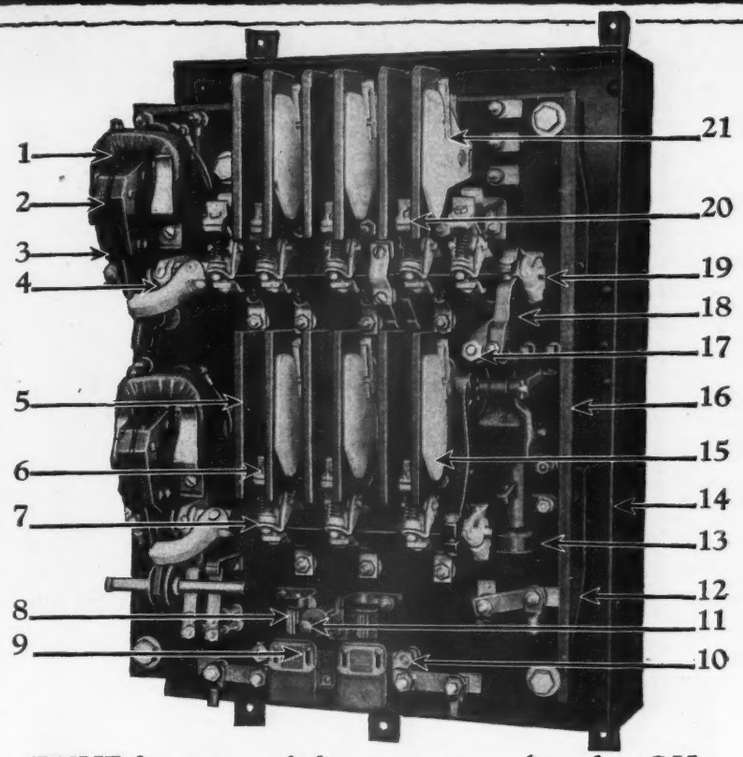
17 Timing adjustment made by simply turning this screw.

18 Mechanical and electrical interlocks insure that starting switch opens before running switch closes.

19 Switches operate on hardened and ground steel bearings.

20 Heavy tinned copper contacts have full roll-and-rub action. Cool operation insures long life.

21 Arc shields entirely removable without tools; provides for their quick replacement or repair and allows easy access to contacts.



THE first year, and for many years thereafter, C-H Auto-Transformer Starters will *always* exceed the demands of your plant—however severe.

"Built to the Standard of Millions of Operations" guarantees exceptional life and performance under every day operating conditions, plus a reserve which means they will always meet your most exacting demands.

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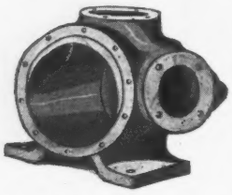

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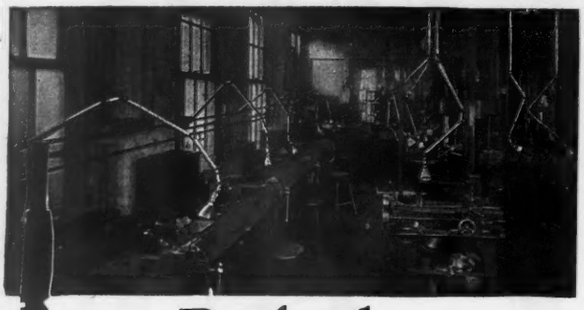

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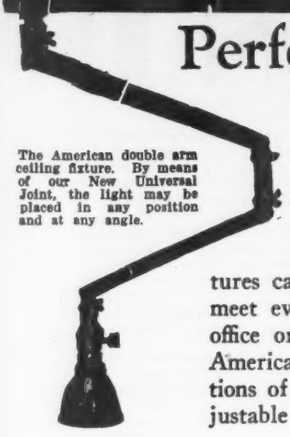

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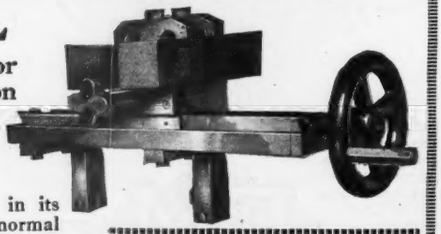

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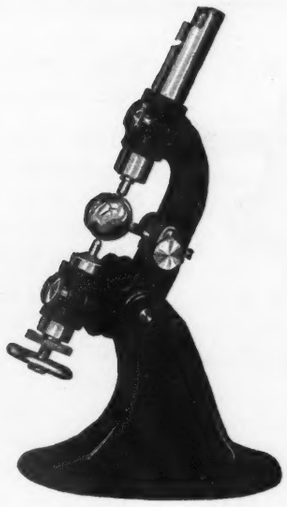

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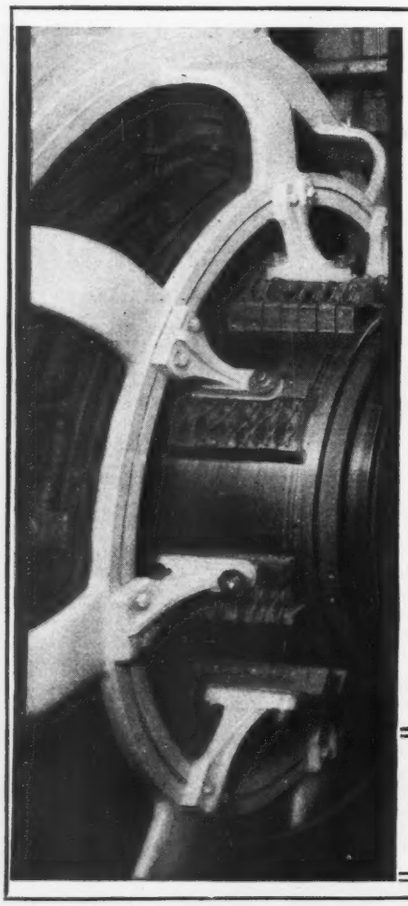

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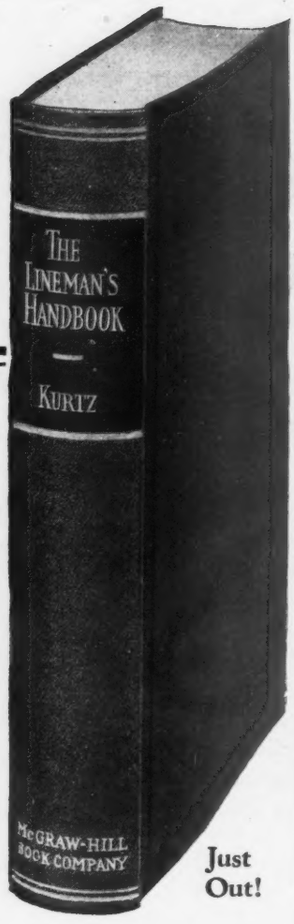

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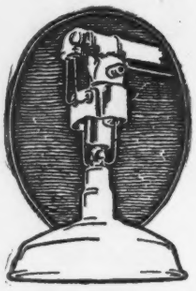

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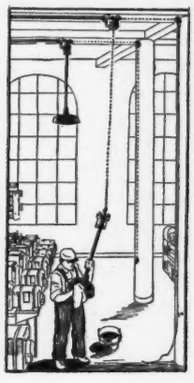

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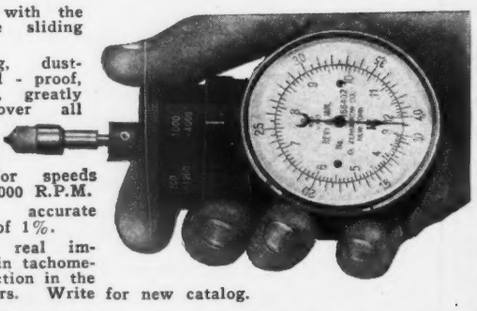

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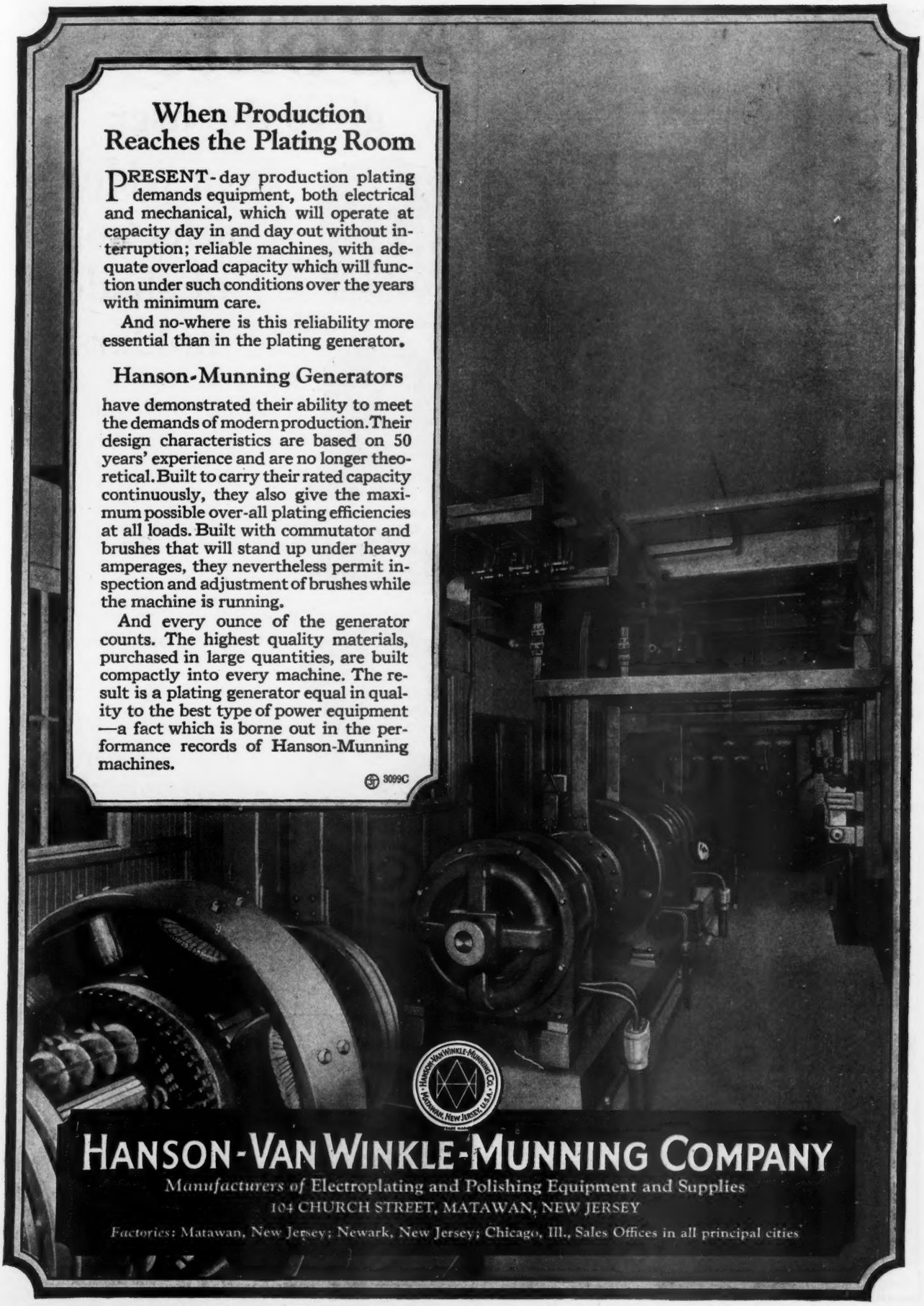

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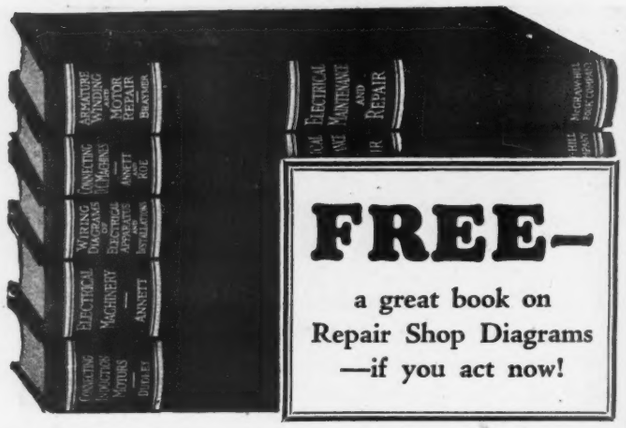

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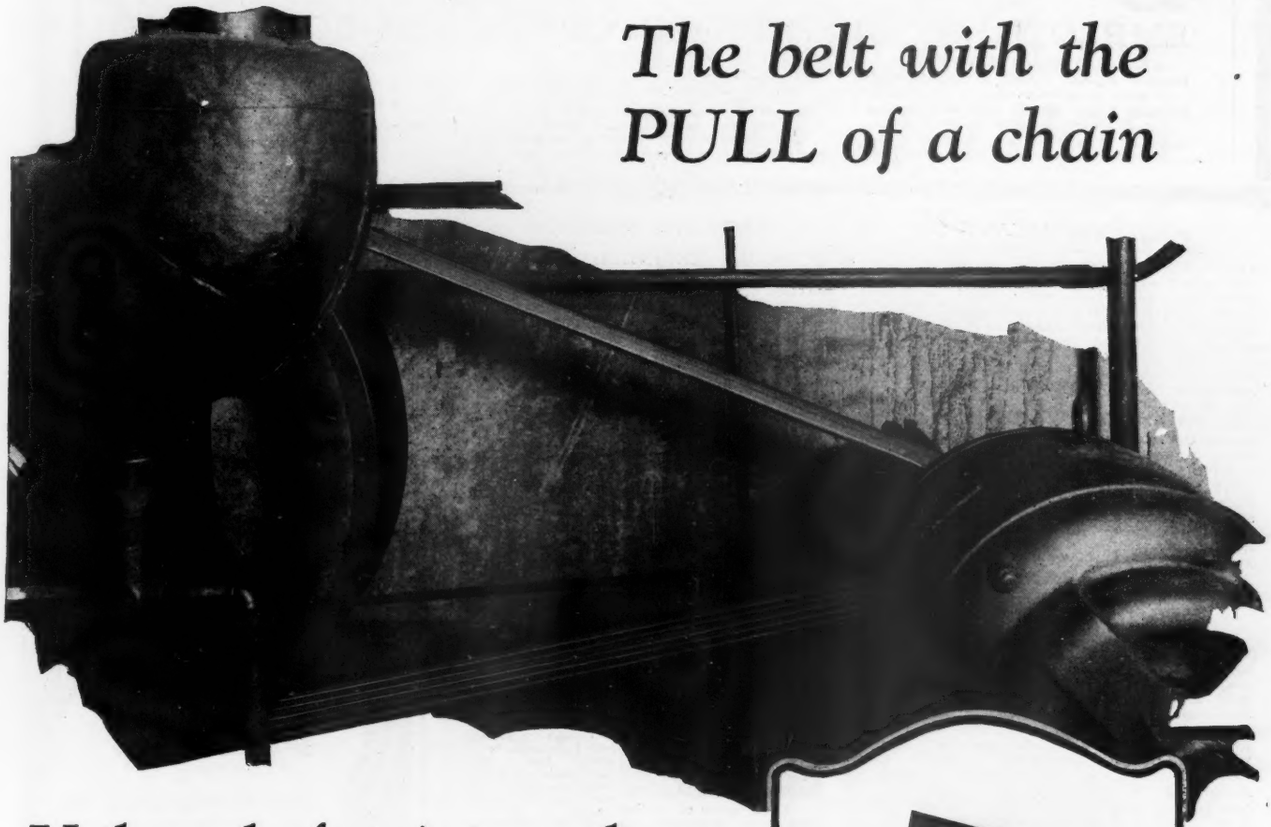

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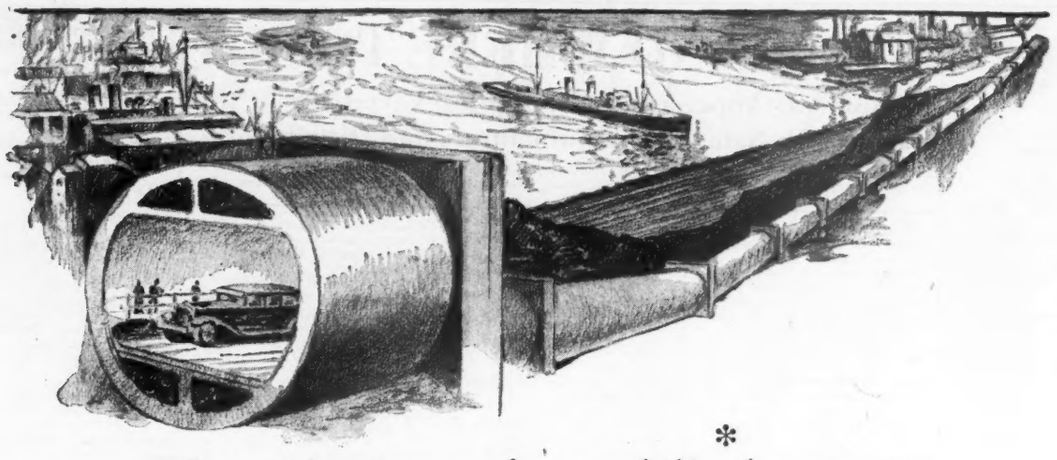

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2,116,000 cu. ft. of air per minute, without fail, is the demand made of the 16 fans. Dangerous exhaust gases from the thousands of automobiles must be drawn away. Fresh air must be pumped in a continuous stream to keep the air fresh—always.

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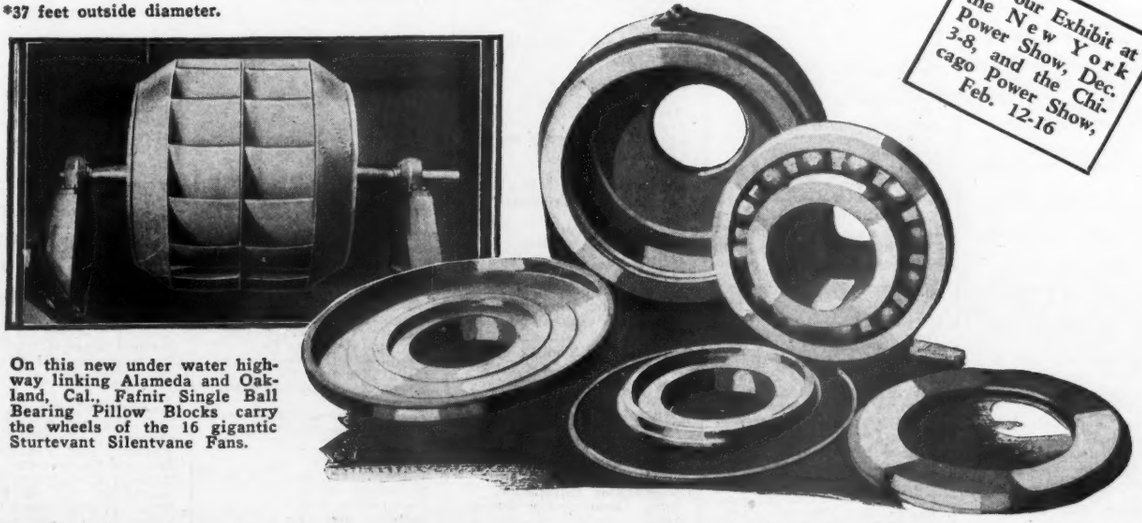

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Leather-link
Schieren Co., Chas. A.
Waterproof Leather
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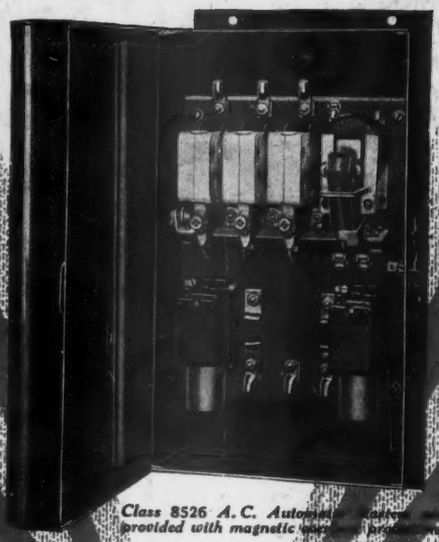

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